MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 35 FEBRUARY, 1929 Number 6

PRINCIPAL ARTICLES IN THIS NUMBER

Bonus System Increases Tool-room Output Forty Per Cent—*By Emil Gibian*.. 401
Modern Methods in Southern Pacific Shops—*By C. W. Geiger*..... 406
Making Micarta Airplane Propellers—*By R. L. Knight*..... 409
How to Eliminate Lubrication Troubles—*By Herbert A. Freeman*..... 412
Hiring and Training of Crane Operators—*By Benjamin Hantman*..... 415
Current Editorial Comment..... 418
Production's Effect on Wages—Tool-room Bonus Systems—Wasting Money on Worn Out Machines—Motion Pictures for Demonstrations
The Outlook for Commercial Aviation—*By C. M. Keys*..... 419
Ingenious Mechanical Movements..... 422
Special Tools for Railway Shops..... 425
Multiple-spindle Drill Jigs—*By S. J. Helweg*..... 428
Chromium Plating for Wear Resistance—*By W. Blum*..... 430
Methods Used in Molding Bakelite Parts—By *R. A. Lowe*..... 433
Making Irregular-shaped Flanged Cylinders—*By Lucien L. Haas*..... 438
The Machining of Vulcanized Fiber—*By N. S. Baer*..... 451
Formula for Worm and Spiral Gear Train—*By W. E. Trask*..... 453
"Carboloy" and Tungsten Carbide Tools—*By Samuel L. Hoyt*..... 457

DEPARTMENTS

What MACHINERY'S Readers Think..... 407
Notes and Comment on Engineering Topics..... 417
Letters on Practical Subjects..... 441
Shop and Drafting-room Kinks..... 449
Questions and Answers..... 450
New Machinery and Shop Equipment..... 461

Total Distribution for January, 16,626 Copies

Product Index 318-338 Advertisers Index 341-342

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS, 140-148 LAFAYETTE STREET, NEW YORK

ALEXANDER LUCHARS, President ROBERT B. LUCHARS, Vice-President EDGAR A. BECKER, Treasurer
ERIK OBERG, Editor FRANKLIN D. JONES, Associate Editor CHARLES O. HERB, Assistant Editor FREEMAN C. DUSTON, Assistant Editor
LONDON: 52 Chancery Lane PARIS: 15 Rue Bleue

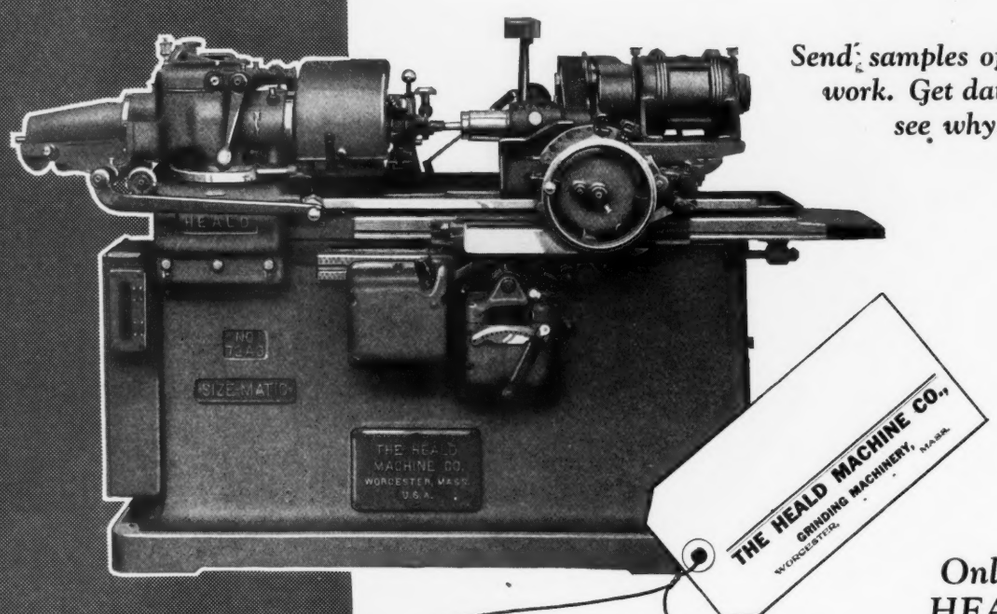
YEARLY SUBSCRIPTION: United States and Canada, $3 (two years, $5); foreign countries, $6. Single copies, 40 cents.

Copyright 1929 by The Industrial Press. Entered as second-class mail matter, September, 1894, at the Post Office in New York, N. Y., under the Act of March 3, 1879. Printed in the United States of America.

Don't You Need a New *INTERNAL?*

With hundreds now in operation, distributed among metal working industries of every description, proves conclusively the universality and acceptance of Heald Automatic Internal Grinding Machines.

So satisfactory have been the results that very often Heald Automatics are replacing equipment less than five years old.



Send samples of YOUR work. Get data and see why.

Only a HEALD is Automatic

Let us tag this machine for you

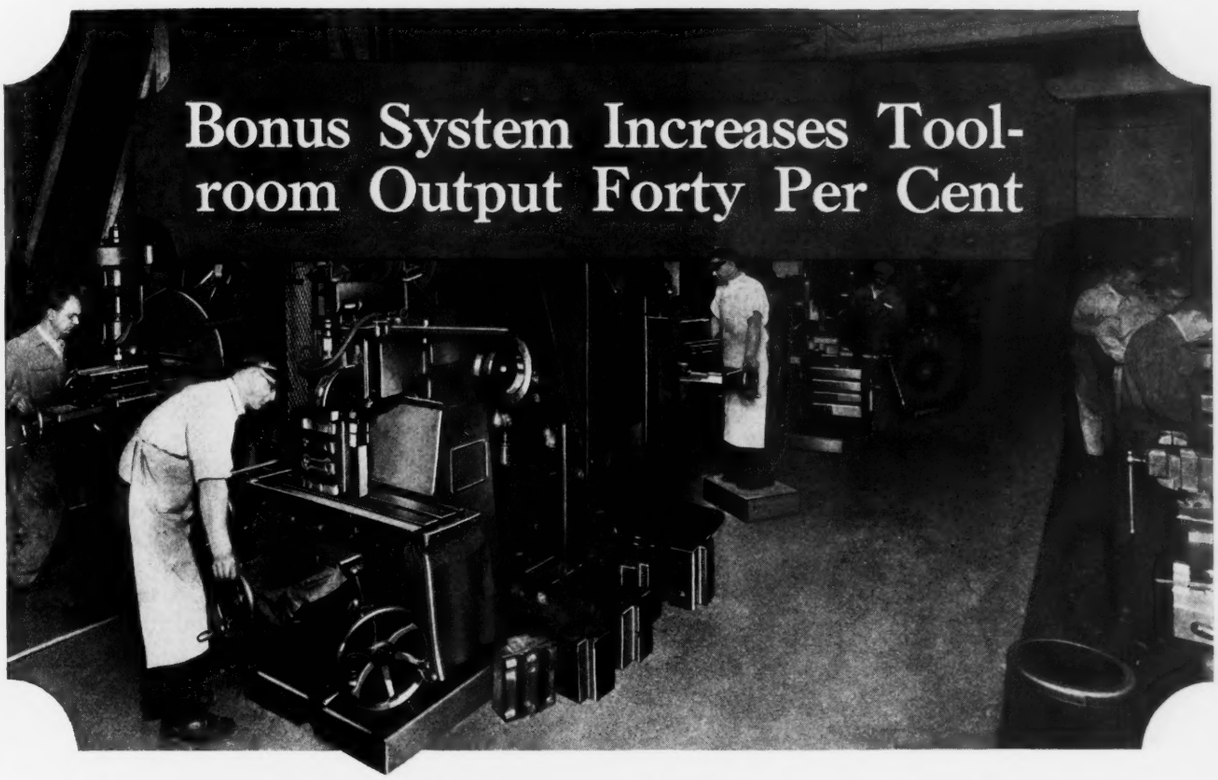
Over 100 years of trade confidence

HEALD

The Machine Company, Worcester, Mass., U.S.A.

MACHINERY

Volume 35 NEW YORK, FEBRUARY, 1929 Number 6



Bonus System Increases Tool-room Output Forty Per Cent

Description of An Incentive Payment Plan that has Increased the Income of the Toolmakers and Reduced the Costs of the Company

By EMIL GIBIAN, Chief Engineer, The Vlchek Tool Co., Cleveland, Ohio

TWO arguments are commonly advanced against the adoption of incentive wage payment systems in tool-rooms. The first of these is that the work in a tool-room is not of a sufficiently repetitive character to permit convenient or fair setting of bonus rates. This may be a valid reason in some shops, but there are many tool-rooms where the work is similar enough to enable easy and intelligent establishment of bonus rates. In the tool-room of the Vlchek Tool Co., Cleveland, Ohio, where twenty-five toolmakers are regularly employed, approximately 90 per cent of the tools and drop-forge dies made are produced under an incentive payment plan that is to be described in this article.

The second argument advanced against the adoption of bonus systems in tool-rooms is that toolmakers and die-makers, if paid a bonus for expediting their work, are likely to produce work that is not so accurate as when they are paid according to the time actually spent on the job. The experience of the Vlchek Tool Co. has been otherwise; parts are made fully as accurately under the bonus system as they were before the system was adopted, in spite of the fact that the output of the men has been increased 40 per cent. A description of the system by which this has been accomplished is therefore of real importance to the industry.

A Wage Payment Plan Advantageous to Both the Men and Management

Important advantages have accrued to both the toolmakers and the management from the incentive payment system used in the tool-room of the company mentioned. The practice is to set a standard time for performing the various jobs issued to the tool-room. If a toolmaker or diemaker

EMIL GIBIAN graduated from the Bohemian Technical College at Prague, Czecho-slovakia, in mechanical engineering, in 1921. After his graduation, he was employed for two years by the Skoda Works at Pilsen as a designing engineer on mining machinery and material-handling equipment. Late in 1923 he came to the United States and was first employed by the Jeffrey Mfg. Co., Columbus, Ohio, builder of material-handling equipment, mining machinery, conveyors, etc. In 1925 Mr. Gibian became chief engineer of the Vlchek Tool Co., Cleveland, Ohio. In this capacity, he has supervised the designing of new machinery and appliances; the installation of conveyors and other facilities for expediting the movement of work between departments; and the development of an incentive wage payment system.

THE V. T. CO. FORM 103 9-27

TOOL DEPARTMENT REQUISITION

DATE 9-25-28

PLEASE ISSUE THE FOLLOWING ORDER:

MAKE 6 Hold-down stops for planer F-M-12

~~RETURN~~

~~CHANGE~~

ORDER NO.	PART NO.	DATE WANTED
7156		10-1-28

MIN. MAX. SIGNED A. W.

Fig. 1. Requisition Slip Made out by the Various Foremen in Ordering Tools or Dies from the Tool-room

does any job in less time than the standard specified, he is paid a bonus equal to his hourly wage multiplied by 50 per cent of the time saved. In other words, if the standard time specified for a certain milling operation on a die is 10 hours and the toolmaker finishes this operation in 7 hours, he will be paid his hourly wage times 8 1/2 hours.

That the toolmakers have benefitted substantially from the bonus system is shown by the fact that the average man makes approximately 18 per cent more money on bonus jobs than he was paid for the same work on a straight time basis. The men cannot lose, because if they consume the standard time, or even more, on any job, they are paid their hourly wage for the entire time spent in doing the work.

On the particular job referred to, the company would save at least 1 1/2 hours of the man's time, because, as indicated by records of past performance, if the man were not being paid a bonus, it would take him fully 10 hours to do the job, and probably longer. In addition, the company would benefit from the fact that the overhead charge on the job would be reduced the entire 3 hours saved.

Thus, the company actually saves more money under the bonus system than it pays out in increased earnings to the men, but another advantage of major importance to the company is that the tie-up of drop-forge hammers or other machines, which formerly occurred with considerable frequency, has now been eliminated. This is due to the fact that dies and other tools are being produced on schedule to meet the requirements of the shop. Still another advantage is that 40 per cent more work is turned out with the same number of men and the same amount of equipment. To keep up with the increased production of the shop, more men, machines, and shop space would have been necessary under the old payment plan.

Preparations Made for Installing the Bonus System

For approximately one year before the adoption of the bonus system, records were carefully made of each job going through the tool-room. Not only was the total time spent on each job recorded, but also the time consumed on each individual operation of a job. Many time studies were made and the performance of machines observed. From these records, it was comparatively easy to establish standard times for most jobs. It is the practice to specify standard times for each operation rather than for the job as a whole.

In any concern there are always some workmen who will view new wage payment plans with a certain degree of suspicion, and to insure the success of this bonus system from the start, it was established gradually by first placing under it toolmakers who could realize its advantages both to the employer and to the employe. When others who at first questioned the motive of the company saw the larger wages that their fellow toolmakers made under the bonus system, they were more than anxious to be paid on the same plan.

The confidence of the men was obtained by establishing the rule that no standard time is ever to be reduced, even though the time specified on a given job is so high as to permit the earning of a bonus altogether out of proportion to the job. Knowing this, the men endeavor to reduce their time on each job just as much as possible. To make this rule fair to the company, however, standard times are specified only after a careful study of each operation.

On the other hand, if a man fails to earn a bonus on any job, the standard time is not increased immediately in answer to his protest. But, if a subsequent investigation shows that the standard time is really set too low, it is increased without comment after a lapse of a month or two.

Controlling the Payment of Bonuses

Simplicity is a much desired virtue of any system, and that fact was kept in mind while devising the means for controlling the payment of bonuses under the system here described. This system, as finally adopted, has three aims: (1) To keep records of all work that has been done in the tool-room; (2) to establish standard operation times as a basis for paying bonuses; and (3) to schedule, direct, and check the work of the tool-room.

Orders on the tool-room originate with the engineering department or with the foremen of the shop who fill out the requisition slip shown in Fig. 1 for any parts needed by their respective depart-

GROUP F-II-3a — TOOL ROOM STANDARDS — TOOL NO. — DWG. NO. X-62-F

TOOL: Hold-down Stops for Planer F-M-12. Make six pieces.

OPERATION	HRS.	BILL OF MATERIAL	REMARKS
~~Shaping~~	2.5B	2.7 lbs. 3½"X1½" Mch. Steel	B=Bonus
Drilling	1.5B		
Benchwork	2.0B		
~~Harden~~	0.5		
TOTAL	6.5		

DATE 6-21-28 SIGNED: E. G. A. W.

FORM 188 1M 6-28

Fig. 2. Card Used as a Permanent Record of the Standard Times Set for the Various Operations of Each Job

ments. This requisition is forwarded to the engineering department, where a work order blank, such as illustrated in Fig. 6, is filled out along the top and down the left-hand side to cover the job. After the work order number has been marked on the requisition slip, the latter is returned to the foreman who issued it, as an indication that favorable action has been taken.

It will be seen from Fig. 6 that the job to be performed by the tool-room is subdivided according to the various operations, and that the estimated or standard time for each of these operations is entered. All operations on which a bonus is to be paid are indicated by adding the letter "B" in back of the time given for those operations. For the convenience of the tool-room foreman, a line is drawn in red crayon across the upper left-hand corner of each work order that authorizes any operation on which a bonus can be earned. The itemized list of operations, together with their estimated or standard times and the material specifications, are taken from "Tool-room Standards" cards, such as shown in Fig. 2. These cards constitute records of performance when the same or similar jobs were previously put through the tool-room.

The work order is made out in triplicate on white, pink, and yellow paper. The white copy is sent to the tool-room to authorize the job, the pink copy is retained in the engineering department, and the yellow copy is sent to the cost department. The yellow copy differs from the other two in that where the columns marked "D", "Check," and "Time" occur on those copies, columns headed "Hours", "Labor," and "Expense" appear on the yellow copy.

When the white tool-room work order reaches the tool-room foreman, he files it temporarily until he can assign the first operation to a toolmaker. First, however, he makes out a requisition for the necessary material on the slip shown in Fig. 4, which is forwarded to the raw stock-room. In the engineering department, a record is kept of all material used, so that it is an easy matter to determine at any time just how much stock of each kind and size of raw material there is on hand. After the material has been delivered to the tool-room, this requisition slip goes through the engineering department to the cost department so that an accurate calculation can be made of the material costs on each job.

SUPPLY REQUISITION

Date 9-27-28 Number 7156

Quantity	WANTED Material	Value
2.7 lbs.	Mach. Steel 3½" x 1½" x 18"	

To be used by

Signed L. J.

Form 63 5M 10-25

Fig. 4. Slip Used to Requisition Raw Material

When an operation is assigned to a toolmaker, he receives from the foreman the white work order blank, along with all essential information concerning the operation. After completing his task, the toolmaker returns the order blank to the foreman, who inspects the work.

Toolmakers Punch Clock in Starting and Stopping Each Operation

Cards such as shown in Fig. 5 are punched by a time clock in starting and stopping each operation, after the top and bottom rows have been filled in as shown and the toolmaker's check number marked down. If the toolmaker has finished the operation, the letter "F" is added to the operation number on the time card. At the close of the day, these cards are given to the tool-room foreman who stamps "Bonus" on each card pertaining to operations on which a bonus can be earned. The final time card for a bonus operation is also stamped "Completed." The spaces along the right-hand edge of the time card are filled in subsequently by the payroll department.

From the time cards of the tool-room, which are sent each morning to the engineering department, a clerk determines the actual number of hours spent by the various men on the different jobs. He marks this time on the engineering department copy of the work order as shown in Fig. 6, as well as the operation number, check number of the man, and the date. All this information is entered under the various subdivisions shown under the general heading "Actual Time Applied."

OPERATION	COMPLETED ORDERS 7/12/28 6283	9/29/28 7156
Shaping	2.2	1.9
Drilling	1.0	1.0
Benchwork	1.6	1.5
Harden	0.5	0.5
	5.3	4.9

Fig. 3. Reverse Side of the Card Illustrated in Fig. 2, which is Used to Record the "History" of Various Orders of the Same Job

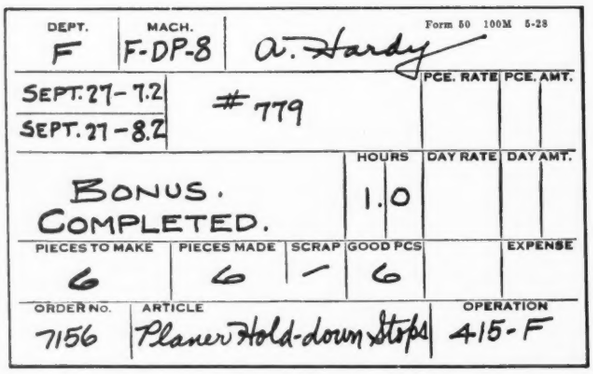
Daily Report of Tool-room Performance

From the time cards, a clerk in the engineering department makes up a daily report, such as illustrated in Fig. 7. Under the column "Actual Applied Hours," he marks the actual time spent by the different toolmakers on each particular operation during the previous day. Under "Actual Total Hours," he marks the total number of hours that have been spent on the operation during the previous and preceding days. From the work order, the clerk obtains the estimated number of hours for each job, and as each operation is completed, he divides the estimated number of hours by the total actual hours spent on the operation, so as to determine

the efficiency of the man's performance in relation to the standard or estimated time. It will be seen that the efficiency ratings on the three jobs listed in Fig. 7 are 131, 150, and 133 per cent, respectively. The various operations on all jobs going through the tool-room are, of course, marked indiscriminately on this list.

A summary is made of each daily tool-room report for the purpose of determining the total number of applied hours shown on the list and the total number of estimated hours, both of jobs on bonus and those that are not, although the two classes are kept separate. In this way, the efficiency of the tool-room for each day can be determined both for bonus work and for work paid on a straight time basis. On this sheet are also listed the amount of estimated hours of new orders issued to the shop during the previous day, and the amount, in estimated hours, of all unfinished work that has been assigned to the tool-room. The aim is to keep about 3000 hours of unfinished work ahead of the tool-room.

A duplicate copy of this report is sent to the tool-room foreman each afternoon to enable him to assign jobs to the various men without having to go from machine to machine to ascertain how nearly the different jobs are completed. Scheduling of work through the tool-room is also facilitated by means of a Gantt chart, which is maintained by the engineering department. After this tool-room report has been made up, all time cards are sent to the payroll department.



DEPT. F | MACH. F-DP-8 | A. Hardy | Form 50 100M 5-28

SEPT. 27-7.2
SEPT. 27-8.2
#779

PCE. RATE | PCE. AMT. | HOURS | DAY RATE | DAY AMT.

BONUS.
COMPLETED.
1.0

PIECES TO MAKE | PIECES MADE | SCRAP | GOOD PCS | EXPENSE

6 | 6 | — | 6

ORDER NO. | ARTICLE | OPERATION

7156 | Planer Hold-down Stops | 415-F

Fig. 5. Typical Time Card, which is Stamped by a Clock when Each Operation is Started and Stopped

From the daily tool-room report, there is also made out the form illustrated in Fig. 8 to show the bonus time to be credited to all toolmakers for the various operations completed the day before. On this sheet is listed the standard or estimated time for the different jobs, the actual time, and the bonus time. The latter is, of course, determined by dividing the difference between the estimated time and the actual time in half. Thus, 6.0 minus 4.4 equals 1.6, and 1.6 divided by 2 equals 0.8.

Duplicate copies of this bonus sheet are made, one of which is sent to the payroll department, where the two columns at the right are filled in and the copy filed. The other copy is retained in the engineering department, after first having been submitted to the tool-room foreman.

The "Tool-room Standards" cards shown in Figs. 2 and 3 are carefully filed, as the front of these

THE V. T. CO. 2500 FORM 105-A 4-28

TOOL DEPT. WORK ORDER No. 7156

DATE WANTED 10-1-28 DATE ISSUED 9-25-28

DESCRIPTION Six Hold-down Stops for Planer F-M-12, as per drawing X-62-F

REQUEST A. H.

MATERIAL REQUIRED

3" X 1½" Machine Steel

ESTIMATED TIME REQUIRED

Shaping	2.5	B
Drilling	1.5	B
Benchwork	2.0	B
Harden	0.5	

TOTAL ESTIMATED TIME 6.5 HRS.

MONTH	AMOUNT	MONTH	AMOUNT

TOTAL ACTUAL TIME APPLIED HRS.

ACTUAL TIME APPLIED

OP. 220			OP. 415			OP. 780			OP. 300			OP.			OP		
D	CHECK	TIME	D	CHECK	TIME	D	CHECK	TIME	D	CHECK	TIME	D	CHECK	TIME	D	CHECK	TIME
9/26	779	1.6	9/27	779	1.0	9/27	779	1.5	9/29	820	0.5						
9/27	779	0.3															

Reported 9-27-28

CHARGE TO ACCOUNT 81 DEPT. F

DATE COMPLETED 9-29-28 AUTHORIZED BY E.G.

Fig. 6. Work Order Issued to the Tool-room to Authorize Jobs

1 M Form 169—8-28 The V. T. Co.

DATE 9-27-28

SHEET NO. 1

DAILY TOOL ROOM REPORT

CHECK NO.	ORDER NO.	ACCT. NO.	ARTICLE	OPERATION	MACH. NO	ESTIMATED HOURS	ACTUAL APPL'D HRS	ACTUAL TOTAL HRS	EFF
779	7156	81-F	Planer Hold-down Stops	220-F	F-SH-3	2.5	0.3	1.9	131
779	"	"	"	415-F	F-DP-8	1.5	1.0	1.0	150
779	"	"	"	780-F	—	2.0	1.5	1.5	133

Fig. 7. Report Made Out Daily of All Work Performed in the Tool-room

cards constitutes an official record of the estimated time established for each operation on the job to which it pertains. The back of the card is used to record the actual time consumed on each operation of the job with every order issued to the tool-room. These cards are filed in groups according to the department in which the part is used, as, for example, forging department, milling department, etc. They are sub-classified in these groups according to machines and parts.

From these standards cards, estimated times can be readily obtained for future jobs of identical or similar nature. Increased or decreased efficiency on the same job, when performed at different times, can also be quickly determined, and the reasons ascertained. Thus, from Fig. 3 it will be seen that in making the planer hold-down stops under order No. 6283 the total time for the job was 5.3 hours, whereas under the work order No. 7156, the job was finished in 4.9 hours. The records on the back of these cards are maintained for a year or two.

One card selected at random from this file showed that before the system was installed, the average time consumed on the respective job amounted to 80 hours, and this was considered good time for a high-grade toolmaker. However, the chief engineer and tool-room foreman decided that there would be a fair chance to earn a bonus if the standard time was set at 70 hours. Under the same conditions, the identical man has since performed the job in 49.6 hours, actually earning a bonus of 10.2 hours and reducing his time 38 per cent.

On another job, the average time of a first-class toolmaker was 42 hours before the installation of the bonus system, and the tool-room foreman believed that to be the best possible time in which the work could be done satisfactorily. Since the policy of paying bonuses was adopted, the same man has gradually cut the time down on the job to 29 hours and does the work fully as accurately as before.

Charts Keep the Management Apprised of Tool-room Conditions

Several charts or diagrams are maintained by the engineering department and submitted monthly to the management. These charts are made up from various records, such as the daily tool-room report. One of them shows the daily and monthly efficiency of the tool-room as determined by dividing the total estimated hours of bonus and non-bonus jobs, respectively, by the total actual applied hours of bonus and non-bonus jobs. Another chart indicates the percentage of tool-room work on the bonus system. Still another diagram shows the amount of unfilled work ahead of the tool-room each day of the preceding month. From charts such as these, the management can readily visualize the performance of the tool-room.

Bonus systems, to be successful, must be sincerely founded on the basis of enabling men to earn substantially increased wages in return for the benefits derived by the company in the way of lower costs and quicker completion of work. Details must, of course, be developed to meet the requirements of individual shops.

TOOL ROOM BONUS

SHEET NO. 32 DATE 9-27-28

CHECK NO.	NAME	ORDER NO.	DESCRIPTION	OPERATION	STANDARD TIME	ACTUAL TIME	BONUS TIME	HOURLY RATE	BONUS
779	Hardy	7156	Made 6 Planer Hold-down Stops	220, 415, 780	6.0	4.4	0.8		

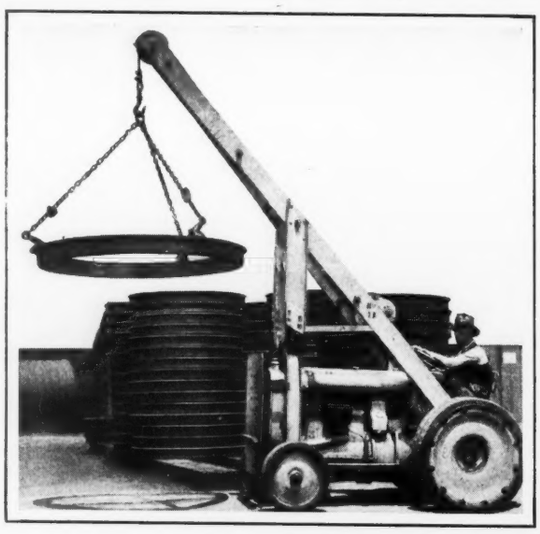
Fig. 8. Form on which the Bonus Time is Listed as Each Tool-room Job is Completed

Modern Methods in Southern Pacific Shops

Some of the Railroad Shops on the Pacific Coast Are Among the Best Equipped in the Country

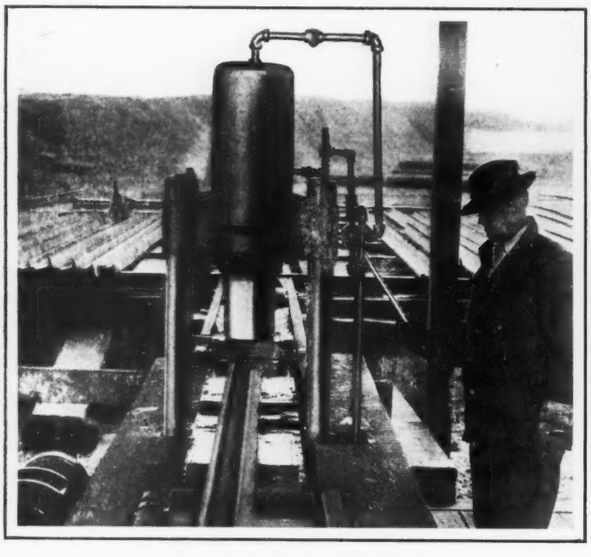
THE orderly storage of materials is one of the evidences of good management. The illustration above shows how neatly supplies are arranged in the stores department of one of the Southern Pacific California shops. A description of the material stored is plainly marked on every compartment, and the price of each piece of stock is also noted.

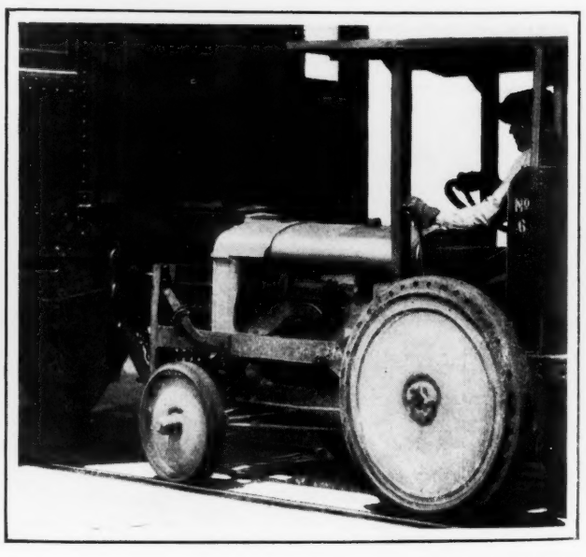
The 1-ton tractor crane, with 12-foot boom, shown in the center, piling up 1700-pound locomotive tires, has saved $5000 annually.



To the left below is shown a 100-ton hydraulic straightening and bending press, capable of straightening 2000 feet of rail a day. This is 500 feet more than was possible by former methods and requires four men less to do the work. To the right is shown how tractors are extensively used for all kinds of operations. Using this tractor for switching passenger cars from the car shop to the paint shop has resulted in a saving of $7.50 a day on this operation alone.

C. W. GEIGER





What MACHINERY'S Readers Think

Brief Contributions of General Interest in the Mechanical Field

PRACTICABLE TOLERANCES

The editorial comment on practicable tolerances on page 100 of October MACHINERY is direct and to the point. There is one phase of the problem that is generally overlooked in the drafting-room, particularly in large organizations where the title block carries a note something like this: "Tolerance ± 0.005 unless otherwise noted." That this is a practical method of handling the matter is not questioned. Unfortunately, when it is used, the draftsman usually scrutinizes his design and marks the places where closer tolerances are required, but seldom looks for the places where more liberal ones can be allowed. This is equally important, for considerable money can be saved if the maximum tolerance is specified in all cases. A tolerance of ±0.005 inch may not be hard to work to, but if ± 1/16 inch is acceptable, it is well worth while to say so.

EDWARD R. MILLER, JR.

SHOULD TOOL DESIGNERS MAKE THEIR OWN DETAIL DRAWINGS?

Some tool designers prefer to do their own detailing. On first thought, this seems uneconomical, because the detailer is paid less than the designer. However, detailing by detailers sometimes costs more than if the designer does the work himself.

In the first place, the detailer is likely to draw the details "as is," with any shortcomings incorporated in the drawings, whereas the designer who details his own work frequently finds something that he can improve upon. He can do the work very much quicker himself, because he is familiar with every detail. If he is to explain the work to another man, he has to spend part of the time that he could use in doing the work himself. To have the designer do his own detailing seems contrary to modern ideas, but there are cases when both time and money can be saved in that way.

JOHN HOMEWOOD

INSTRUCTION FOR INSTRUCTORS

I have read, with keen interest, the comments that have appeared from time to time on "Instruction for Instructors." I, myself, am an instructor in a cooperative engineering school, and perhaps view this matter from a different aspect.

Keeping up with current engineering practice is desirable, but is not always easy. Many engineering problems can be thoroughly studied and solved only through actual contact with them. This means that an instructor, in order to get instruction, must spend alternate periods in teaching and industrial work. The scheme is ideal, but it is not as feasible as it may seem. There are a number of difficulties: Many of our engineering schools are not located in, or even near, industrial centers. Thus, an instructor would be obliged to change his residence in order to do industrial work. Also, my experience has been that manufacturers are not eager to employ instructors. Moreover, I have observed that when an instructor does become connected with an industrial concern, he seldom returns to teaching. Industry retains him because it can pay him better. For the same reason, men are not easily induced to leave industrial work to enter the teaching profession.

These obstacles suffice, I think, to indicate that the transition from teaching to industrial work is not easy. There are other difficulties too, making, on the whole, the matter of instruction for instructors not one of advisability, but one of how and where the instructor can get instruction.

J. W. HUCKERT

HOW MECHANICAL ARTICLES SERVE THE JOBBING SHOP

The article entitled "How Mechanical Articles Serve the Jobbing Shop," on page 169 in November MACHINERY, points out an attitude that is too often assumed by jobbing shop executives. To the writer's mind, articles on production methods should be of the greatest interest to executives of small jobbing shops, because they describe the most economical methods of performing the more important machining operations.

Obviously, the small shop cannot employ the complete methods, systems, or equipment employed in large manufacturing plants. However, the basic principles set forth in articles describing the methods used in such plants form the best possible information for developing the necessarily modified practice of the smaller shops. To have the basic principles right is essential for success in any field, and articles on production methods and practices provide the best means for establishing such principles in small as well as large shops in the machine-building industry.

LEON J. LICHTENSTEIN

BUILDING FROM WITHIN

The idea brought out in the editorial entitled "Building from Within," in November MACHINERY, page 178 should be made use of by every progressive company. The filling of executive positions with employes who have risen from the ranks is usually a better policy than hiring outsiders, provided the employes have shown by their work and conduct that they can fill such positions efficiently. The management can determine which men to select for certain positions by observing the qualities exhibited by the most likely men in the handling of their regular work. Those characteristics that enter into the make-up of a good foreman and

executive will be apparent under the careful observation of the management while the man is employed in a lesser capacity.

Importing executives from the outside is often detrimental to the morale of the plant, and often reduces the efficiency of the workers. When an outside man is given an executive position, many workers naturally feel that conscientious effort and loyalty in performing their work will not be recognized and rewarded through promotion to a higher position, and that the management has little faith in the ability of the employes to advance.

Increased production or efficiency will result from promoting a man whose efforts and work stand out above those of the other workers. An example of this kind is sure to have a stimulating effect upon the other employes. The company will profit by the valuable experience the employe has gained while working for the firm in a lesser capacity. Such an employe will have a better knowledge of the production methods and the proper handling of the workers, because of his experience and proved ability. He will have a practical knowledge of the actual shop work which will prove of great value in carrying out his executive duties.

S. KUPPER

Commenting on the editorial in November MACHINERY, "Building from Within," I believe that executive ability can be stimulated by proper methods. In every organization, there are men who originate plans and others who act under instruction. The first group is said to have initiative and "push." Some men seem to be born with these qualities, and such men forge ahead even under discouraging conditions; but more often these traits are the result of development, of having worked under good leaders, and of having been properly stimulated to greater effort. Only a small number of men have sufficient native energy to forge to the front against all obstacles. It is not possible for a concern to depend on these few alone for their future leaders.

In many of the ablest men, the leadership qualities lie dormant until some conditions bring them out. A system of management by sub-committees, such as is introduced in many large plants, has relieved the chief executive of many of his detail duties and at the same time resulted in the development of executive qualities in younger men. Men develop when given responsibility, and committee leadership places a man in a position where he cannot afford to fail. Many large plants are developing future leaders through committee systems of training, broadening their knowledge of business ethics, economics, and methods. This not only relieves the executive of many details and keeps him in closer touch with his organization, but is also a most excellent training school where men with capacity have an opportunity to show just how far they can go. JOSEPH VIGGIANO

SHOP CONTACT FOR THE DRAFTSMAN

Lack of cooperation means decreased efficiency. This is true in the relationship existing between drafting-room and shop. Without cooperation between departments the plant efficiency is lowered generally. To accomplish greater cooperation, increase the draftsman's interest in his work, and foster a feeling of friendliness between the draftsman and those in charge in the shop, shop contact for draftsmen is advocated.

Primarily, the draftsman himself is benefited. For instance, when a request comes from the shops for enlightenment and the draftsman directly responsible for the drawing is entrusted with the job of explaining his work, the result is beneficial to the draftsman. If he is in error, he will see his shortcomings as he could in no other way. He will be taught to present his instructions in such manner that those to whom they are given will be able to intelligently execute their tasks. He will become "shopwise," and will thus familiarize himself with shop ways of thinking. Furthermore, he will have an opportunity to learn all he can from the foreman's practical experience.

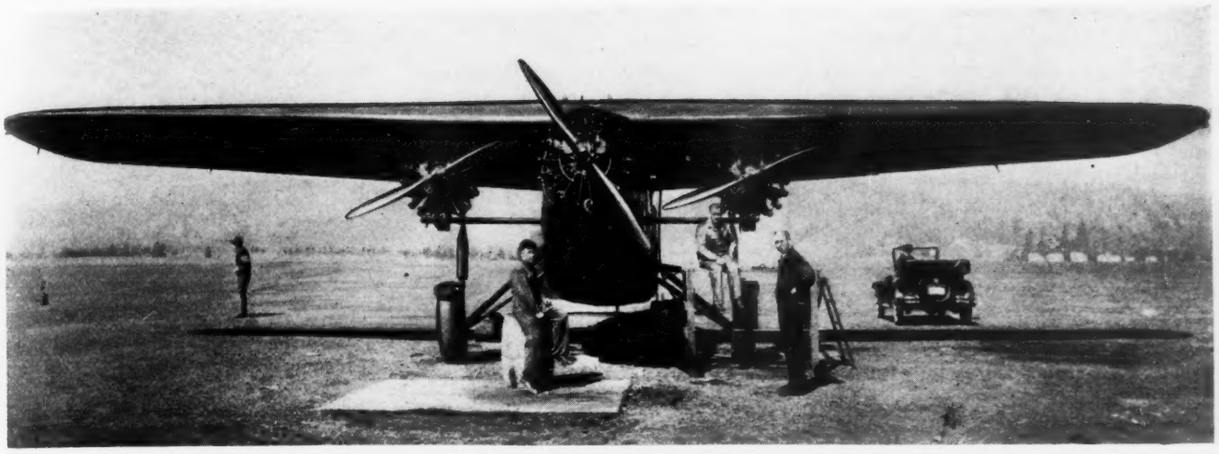
The draftsman's skill and knowledge are also developed by coming in contact with his designs while under way. Seeing the job done may give him ideas for its improvement or suggest a cheaper way of doing the work.

In addition, the workman will be able to do his work more easily. Misunderstandings are the cause of friction and waste. They are considerably lessened when the drawing is made intelligible to the shopmen. Time will be saved directly, because of increased production, and indirectly, by appreciable elimination of error; and the interrelations of office and shop will be conducive to greater cooperation and efficiency. J. GURWITCH

HANDLING CANCELLATION CLAIMS BY ARBITRATION

As pointed out on page 169 in November MACHINERY, the cancellation of an order involves an obligation, but the problem is how to enforce such obligations without incurring ill feeling. One of the most effective methods of meeting this situation with which the writer has come in contact is employed by a trade association outside the machinery field. This association, of which the writer was formerly the secretary, fostered industrial arbitration through its national organization and local divisions.

In the case of a dispute such as often arises over a cancellation, which would involve high legal costs if taken to court, the litigants were urged to sign an arbitration agreement. Each litigant was permitted the choice of one manufacturer to represent him on the arbitration board. The two representatives thus chosen then selected a third member. Both sides presented their cases in an informal manner, and the resulting decision was based on practical business ethics rather than on arbitrary legal technicalities. The only cost under this system was a nominal fee to the arbitrators. Is it not reasonable to assume that the same principles of arbitration may be as successfully applied in the machinery industries? I believe they can, particularly in view of the high sense of honor and intelligence that exists generally in machine-building concerns. JOHN F. HARDECKER



Making Micarta Airplane Propellers

One of the Latest Developments in the Application of Micarta—its Use for Airplane Propellers—is Described in this Article

By R. L. KNIGHT

MICARTA airplane propellers are a combination of special cotton fabric and a synthetic resin made from carbolic acid and formaldehyde. Similar combinations are also used to produce radio panels, restaurant trays, industrial gears, and many other forms of Micarta.

Broadly, two processes are used in the manufacture of Micarta propellers—molding and machining. The exact shape of the blade is produced by molding, and the inner ends are machined for attachment to a steel hub, which is, in turn, securely held to the end of the tapered crankshaft of the airplane motor. Centrifugal force, caused by high rotating speed, and the severe vibration common to such service require that extreme care be exercised throughout the manufacturing process to assure uniform and high grade material, perfect balance of the blades, and perfect fit of the blades to the hub. Obtaining this uniformity and accuracy in a product of such irregular shape presents some problems interesting both to the diemaker and the machinist.

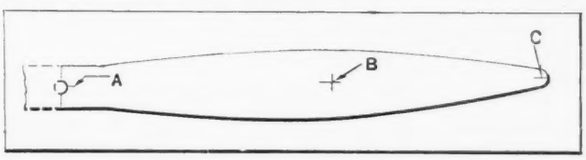


Fig. 1. Gage Points from which All Measurements are Taken in the Manufacture of Micarta Propellers

In the manufacturing process here described, it is first necessary to impregnate the fabric with the synthetic bond. This is done by running the fabric through a vat of liquid bond at a specified speed, and then through a drying oven. This impregnated fabric is then placed in a highly polished, steam-heated mold made of bronze, and is formed into its final shape by subjecting it to several hundred tons of pressure for several hours. The bronze mold is divided into three sections, two of which remain attached to the press when the propeller is removed, the third being removed from the press with the propeller. The latter part is the center portion used in molding the heavy part of the propeller. Both the upper and

Fig. 2. Propeller as it Comes out of the Steam-heated Mold

lower blocks are removed with the propeller, after which the blocks are detached.

Before the laminations for another propeller are placed in the mold, the mold is polished thoroughly, the high polish of the finished propeller depending on the polish of the mold. When the propeller is withdrawn from the mold, it appears as shown in Fig. 2. Gage marks used in setting the center for machining and in setting the angle of the blade are cut into the mold and appear as slight ridges. There are three of these gage marks, as shown in Fig. 1 at *A*, *B*, and *C*. Gage point *B* is the most important of the three, inasmuch as the over-all dimensions of the blade and the angle are reckoned from this point. On the gage-point side, the blade is practically flat from the point to the tip, thus giving a reliable surface from which to make measurements.

The propeller is next sawed in two through the center, and the two separate blades are sent to the

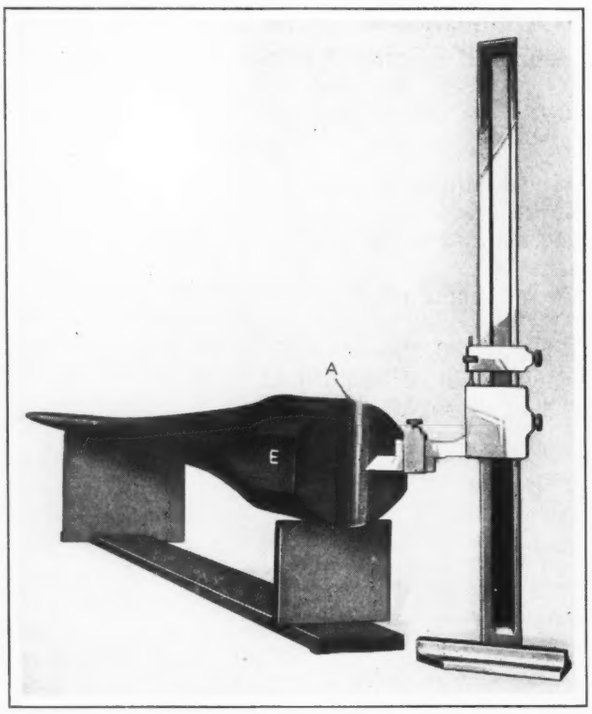


Fig. 3. Determining the Preliminary Center for Rough-machining

machine shop. Fig. 4 shows the progressive stages of the machining operation. It is first necessary to locate a preliminary center in stage *A* to be used in the rough-turning stage *B*. This preliminary center is at the intersection of two lines, one parallel and the other perpendicular to the axis of the propeller. One end of the line parallel to the axis of the propeller is determined by the gage point *A* in Fig. 1. In drawing this line, the propeller is laid on the flat surface *E* (Fig. 3) and the line is drawn exactly parallel to this surface by the use of a height gage. A height gage is used also in determining the line perpendicular to the axis of the propeller. In drawing this line, the propeller is laid on a jig (Fig. 3), similar in construction to a simple book rack, consisting of a flat base piece and two "ends." The gage point *B*, Fig. 1, is placed exactly over the end of the jig farthest away

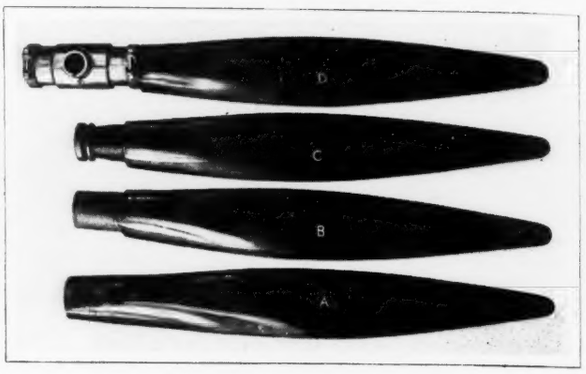


Fig. 4. Stages in the Machining of Micarta Airplane Propellers

from the hub end of the propeller blade. The preliminary center is then drilled in a milling machine set for this purpose.

Machining Preliminary to Balancing

Fig. 5 shows a blade set up in a lathe ready for the rough-machining operation. The blade is set in approximately the correct position by the two gage points *A* and *B* (Fig. 1); that is, point *A* is placed in line with a center point in the lathe chuck, and point *B* is set at the correct height above the lathe bed by the use of a height gage placed on the cross-piece *D*. Then the tailstock spindle is placed in the preliminary center, and any further adjustments that are necessary are made so that the gage point *B* (Fig. 1) is exactly located according to predetermined measurements.

Rough-machining consists of turning the hub end of the propeller down to a size (*C*, Fig. 4) that will fit the fixture used for balancing. In Fig. 8 at *A* are shown the tools used in the rough-machining operations.

To determine the true center of the blade, it is set on the balancing stand illustrated in Fig. 6. In place of the second blade, a fixture is used that exactly compensates for the correct predetermined weight of a single blade. If the blade is in balance, it will assume a vertical position, but if it is out of balance, it will take a position at an angle to the vertical. When the blade has become stationary, it is brought to a vertical position by counterweighting the fixture with small standard weights placed in an offset scale pan. Knowing the weight it takes to compensate for the unbalance of the blade, it remains to calculate by formula the error that was made in setting the preliminary center. The final center is drilled by the same

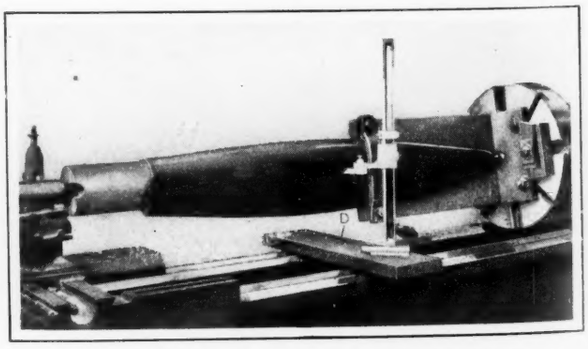


Fig. 5. Blade of Propeller Set up for Machining

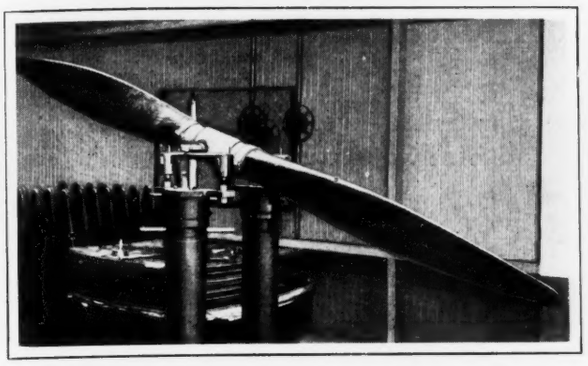


Fig. 6. Propeller in Static Balancing Machine

machine that was used to drill the preliminary center.

Machining to Fit Blade to Metal Hub

For the final machining operation, the blade is set up in the lathe in the same manner as in the preliminary process. The final process consists of machining the hub end of the blade to fit the steel hub already referred to. The hub end of the blade is finished to a specified distance from the gage point *B* (Fig. 1), this distance depending on the type of hub used and on the engine for which the propeller is being made. At *B* in Fig. 8 are shown the tools and templet used in the finish-machining process.

Airplane propellers, on account of the light supporting structure, must be in both dynamic and aerodynamic balance. Fortunately, because of the short lengths in the axial direction, static balancing may be substituted for dynamic. Aerodynamic balance necessitates uniformity of the shape of the propeller blades and of the material used in their construction. When the blade is machined, a hole is drilled in the end to be used for fine adjustment of balance. This is necessary to balance the blade horizontally.

Final Balancing and Setting of Pitch Angle

In balancing the blade horizontally, it is placed in the balancing machine in the same fixture that was used for balancing vertically. The blade and fixture are set in a horizontal plane, and balance is obtained by adding or removing weight to or from the drilled hole. To check the vertical balance of the complete propeller, two matched blades are set up in the balancing machine, as shown in Fig. 6.

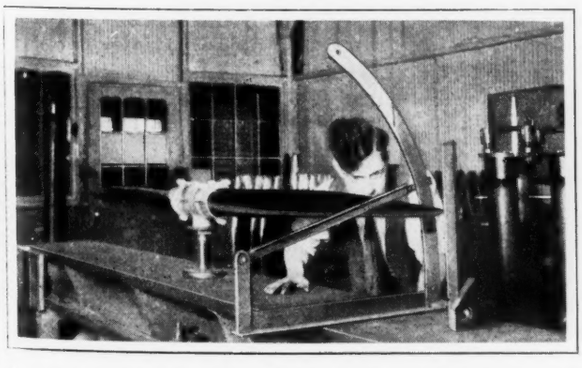


Fig. 7. Setting the Pitch Angle with Adjustable Protractor

These propellers are of the adjustable-pitch type. They can be set to suit different airplane designs or give a different performance with the same airplane. A high-pitch setting gives good cruising efficiency. A low-pitch setting provides quick take-off, which is advantageous in a small field.

The method of setting the pitch angle of the blades is illustrated in Fig. 7. The blade is pivoted to a vertical support on a carefully leveled table, and the angle is set by the use of the adjustable protractor. This angle is set across the flat side of the blade at the gage point *B*, Fig. 1. When the angles of both blades are set, they are firmly fixed to the steel hub, and the complete propeller is ready for test and shipment.

* * *

THE WESTERN METAL CONGRESS

The first meeting and exposition of its kind held on the Pacific Coast was staged under the direction of the American Society for Steel Treating in Los

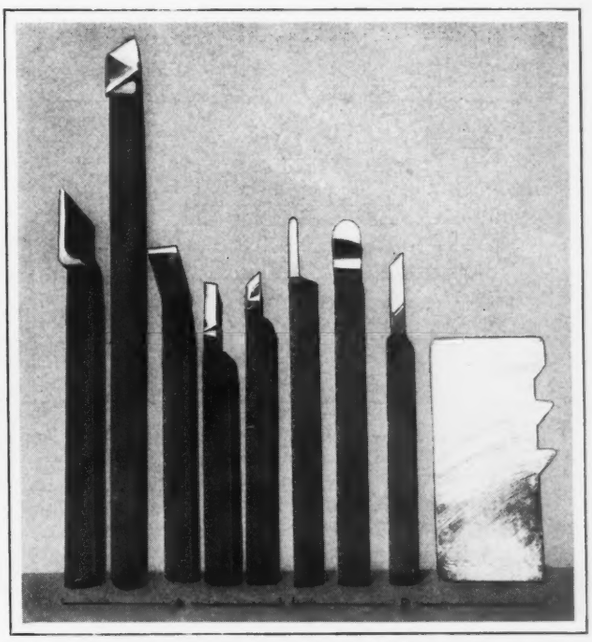


Fig. 8. Tools Used in Rough- and Finish-machining Operations

Angeles, Calif., during the week beginning January 14, as the Western Metal Congress and the Western States Metal and Machinery Exposition. Numerous associations and societies cooperated with the American Society for Steel Treating in bringing about a most successful meeting. A special train of the Santa Fé Railroad carried delegates to the congress and visitors to the exposition, from Chicago to Los Angeles, where headquarters were established at the Hotel Biltmore. Technical sessions were held both at the Biltmore and at the Shrine Auditorium where the exposition was held. Over forty technical papers referring to almost every branch of steel manufacture and heat-treatment were presented. Many papers referred especially to the industrial requirements of the Pacific Coast. Nearly 140 exhibitors were represented, of which about 75 were firms located in the eastern part of the United States.

How to Eliminate Lubrication Troubles

A Study into the Causes of Oil Slinging and Leakage of Bearings, and Suggested Remedies—Second of Two Articles

By HERBERT A. FREEMAN

VARIOUS common causes of oil slinging and leaking from shaft bearings, and methods of correcting such troubles in existing installations, as well as preventives for new designs, were discussed in an article published in January, MACHINERY. The present article will deal with some other common troubles and their remedies.

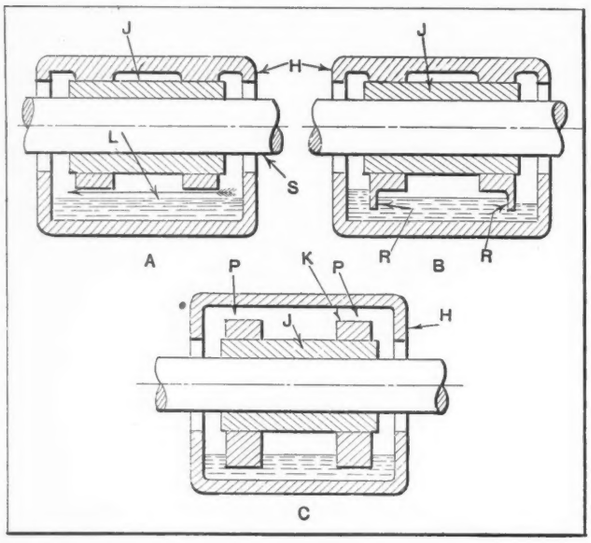


Fig. 9. View Showing the Advantages of Air Barriers and Ducts in Bearings

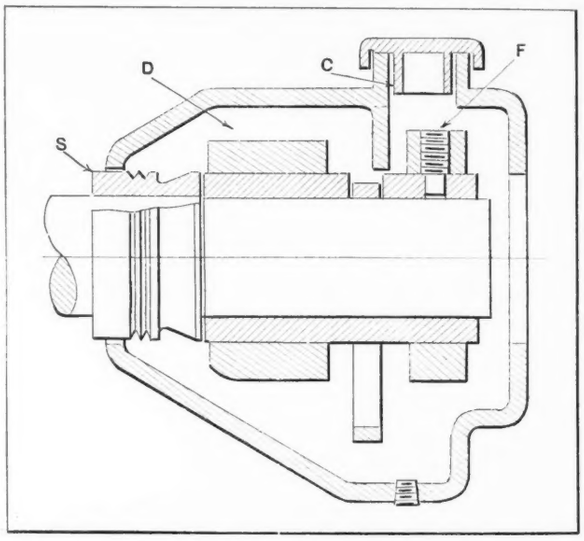


Fig. 10. Commercial Shaft Bearing with Overhead Air Duct and Oil-hole Cover having a Skirt

Fig. 9 shows vertical cross-sections of typical bearings, in which *H* is the housing, *J* the journal box, and *S* the shaft. At *A*, the direction of the "windage" is assumed to be as indicated by the arrow. If the oil level *L* is below the under surface of the journal-box supports, as shown, air currents pick up and carry out of the bearing all the foam and oil particles on the surface of the oil.

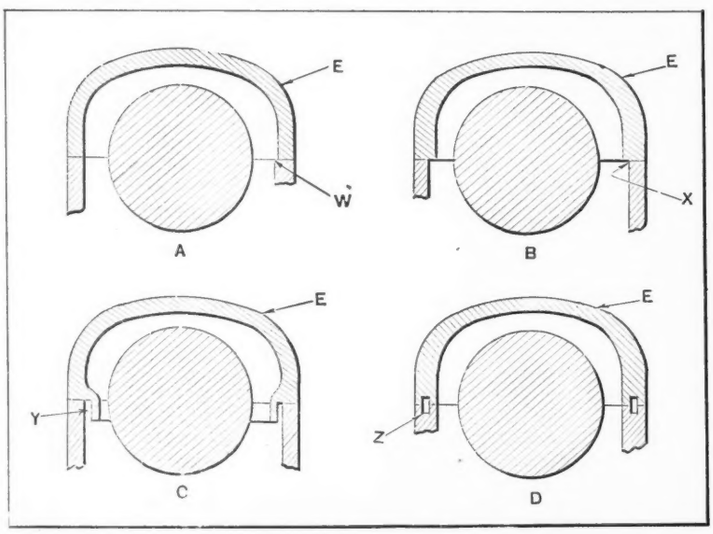


Fig. 11. One Faulty Housing-cap Design and Three Good Ones

Avoiding Trouble Caused by Air Currents

The air current can be trapped by extending into the surface of the oil, barriers *R*, as shown at *B*. Then the air will no longer pass through the bearing, but the "windage" will result in a different oil level in each of the now separate compartments of the bearing, as shown. A pressure of only half an ounce per square inch will cause a difference in the oil level of one inch, and any unusual "windage" will result in the oil being raised to such an extent that it will flow out of the bearing at the nose. Thus in getting rid of one trouble a worse one develops.

However, if the bearing compartments are joined by a duct in the roof of the housing, as illustrated at *C*, the air pressure can be equalized in the compartments and the air by-passed, thus eliminating the tendency toward a stepped oil level and consequent flooding. Furthermore by putting this duct as high as possible in the average bearing, it is in the region of least oil particles and foam. The construction shown at *C* is one of the really important improvements in bearing design, and is coming rapidly into general use. Fig. 4 of the previous article and Fig. 10 of the present one, show at *D* ducts provided in commercial bearings of recent design.

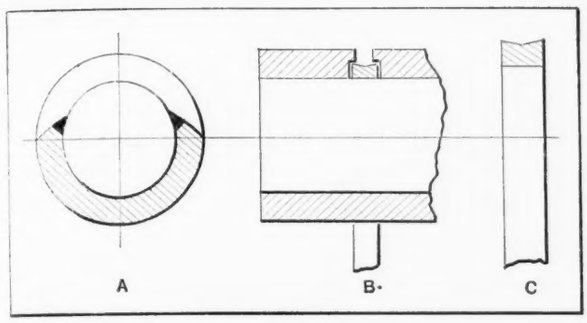


Fig. 12. Construction Details which Eliminate Oil Spatter or Spray

Fortunately for the "trouble man," the equivalent of this port construction can be easily obtained in many bearings by milling a groove in the upper outer surface of the journal box, as shown at *D* in Fig. 8 of the previous article. While barriers *R* at *B* in Fig. 9 are adequate, as far as functioning goes, it is hard to free them from core sand when cleaning the castings, and so they are generally made as shown at *C*. The cored ducts *P* in this view should be made generous in cross-section, so that they will not become choked with burnt sand when cast.

Leakage Through Oil Gages

Leakage through oil gages, assuming the gages to be in good condition, may be caused either by unbalanced air pressure in the bearings, as already discussed, or, in case the ring-oiling method is used, by wash from the oil-ring. To ascertain the seriousness of the latter condition, stop the movement of the oil-ring momentarily with the finger while the machine is running. If any great change in the oil level accompanies this, the only thing to do is to relocate the gage away from the wash.

In making new designs, the portion of the oil cellar with which the gage communicates should be made as capacious as feasible, so that the change of level due to piling up of the oil by the ring may be as small as possible. Also, the oil gage should be located very close to the vertical center line of the bearing. The further away from the center line, the more likely the gage is to overflow if the machine stands a little out of plumb in service.

Leakage Past Oil Lids

Leakage past oil lids is generally confined to machines using oil-ring lubrication, and is caused either by spatter from the oil-rings or by the vaporization of the oil due to high shaft velocities. In making a new design, no plane perpendicular to the shaft should pass through both the ring slot and the oil-hole. Some manufacturers have gone so far the other way that no straight line can be drawn through the oil-ring and oil-hole and into the room. The disadvantage of this design is the impossibility of seeing the oil-ring.

In case oil spatter is caused by an excessive oil-ring speed, a larger oil-ring may be used, if space permits. The increased dip of the larger ring into the oil will give the oil more of a braking action. Also, due to its larger diameter, there is a lower ring speed. For a given peripheral ring speed, the larger the ring diameter, the fewer will be the particles on its surface tending to fly off. A braking action can also be secured by decreasing the clearance between the ring slot and the ring, and by providing tapers at the ends of the ring slot, so that the entering oil forms a sort of wedge.

With split journal boxes, ring spatter can be virtually eliminated by shrouding the oil-ring slot, as shown at *B* in Fig. 12, and by shaping the outer surface of the oil-ring, as illustrated at *C*. In existing installations when the oil-hole is within range of the oil-ring, spatter may be greatly lessened or eliminated by providing the oil-hole cover with a deep inner skirt or shroud, as shown at *C* in Fig. 10. This skirt serves to deflect the spatter.

Cases of trouble arising from atomizing of the lubricant, as mentioned in connection with view *C* in Fig. 1 of the first article, may be treated in a number of ways. Escape of atomized oil at the ring slot may be greatly lessened by the construction details shown in Fig. 12. At *A*, as illustrated in solid black for clearness, there are deep pockets at the beginning of the oil-grooves from the oil-ring slot. These pockets trap the spray issuing from the oil-grooves. Construction details *B* and *C* act the same as they do in connection with the coarser ring spatter just considered.

Issuance of spray at the ends of a journal box may be minimized by the use of a series of pressure-relief grooves, each separately vented and communicating with a port in the bearing support, the lower end of which is under oil, as shown in Fig. 13 at *P*. Ring lubrication, from the standpoint of design, is less desirable than forced-pump lubrication, at speeds greater than 4000 revolutions per minute, or shaft velocities exceeding 4000 feet per minute.

Preventing Seepage of Oil Past Screws

In the past, many manufacturers avoided the seepage of oil past journal-box set-screws, by shellacking them in, when assembling a machine. Of course, when one of these screws is removed and replaced, the seal is broken and trouble may start. In such a case, an axial groove around the lower end of the threaded portion of the screw helps by breaking capillarity. But oil leakage at

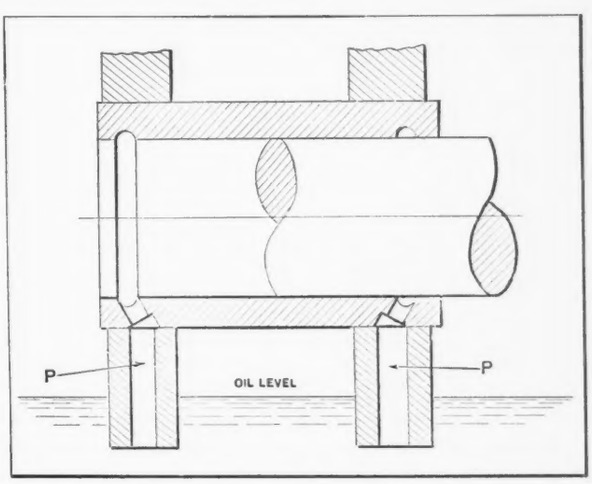


Fig. 13. Bearing Design in which Pressure Relief Grooves and Ports Reduce Spray to a Minimum

this point should be avoided in the first place by proper bearing construction.

In the case of solid journal boxes, where the outer end of the set-screw must be exposed for constructional reasons, the design illustrated in Fig. 15 should be used. Here the hole that the set-screw enters in the journal box does not break out into the bore. The set-screw should be provided with a head that seats against the bearing housing before the lower end can touch the journal box. This construction does away with the danger of forcing the thin journal-box wall at the end of the screw into heavy contact with the shaft, thereby cutting the journal. If possible, however, the set-screw should be wholly concealed, as at *F* in Fig. 10.

In the case of split bearing housings, there is no need for journal-box set-screws, as the journal box can be held against rotation by lugs or dowels engaging suitable pockets in the under surface of the housing cap. It is evident, however, that if such lugs engage the lower part of the pedestal or housing, disassembly difficulties are greatly increased.

Guarding Against Seepage of Oil Through Joints

The seepage of oil through and along the joint of a split housing or pedestal or one having detachable caps is often most exasperating, as the more the cap-bolts are tightened, the greater the leakage. When aluminum-zinc alloy journal boxes are used, enough clearance must be provided between the journal-box seat in the pedestal and the journal box to insure freedom from seizure of the shaft when the box warms up. Such alloys have a much larger coefficient of expansion by heat than cast iron, a fact that is in no way detrimental to their proper use. The housing cap should rest solidly on the housing when bolted up.

When journal boxes comprise babbitt-lined cast-iron shells, the journal-box seats are usually so dimensioned that they grip the boxes tightly when the cap-bolts are drawn up. To insure this condition, it is common practice, in boring out the housings, for the machine operator to insert paper liners between the housing and the cap. These shims are removed after the boring operation, and the space they occupied permits the proper amount of draw-up when the journal box is gripped between the cap and the housing.

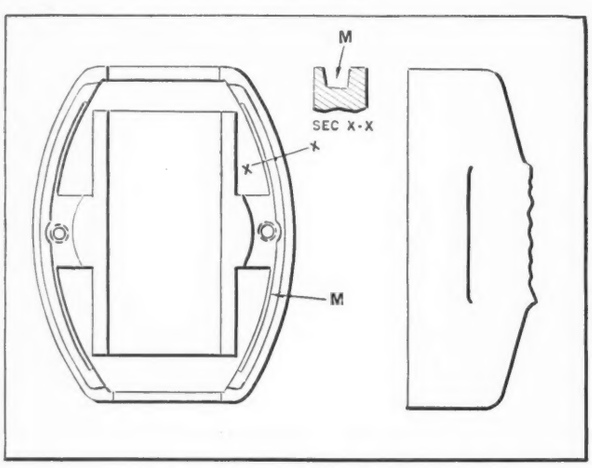


Fig. 14. Bearing Joint Design in which a Groove Extends the Entire Length on Each Side

Obviously, under these conditions, the cap cannot be bolted down so tightly that no crack exists between it and the housing. Leakage at this point can be overcome either by keeping all oil from the joint, or by breaking the capillarity in the joint so that the oil will not creep through. Fig. 11 shows diagrammatically cross-section views through split housings. To keep oil away from the joint, the cap *E* may be so designed that it considerably overhangs the housing, as at *X* in view *B*, thereby avoiding the condition shown at *W* in view *A*, where, due to cores shifting, a shelf has been left on which oil may collect and escape through the split. Then, again, a lip may be provided, as at *Y* in view *C*, to guard the joint from oil. This often means more complicated patterns and slightly higher machining costs, but is good practice.

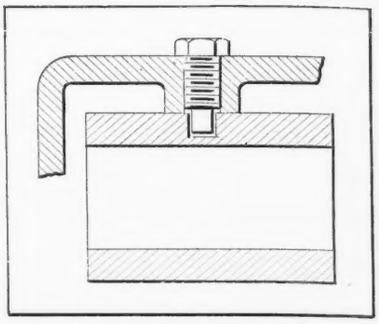
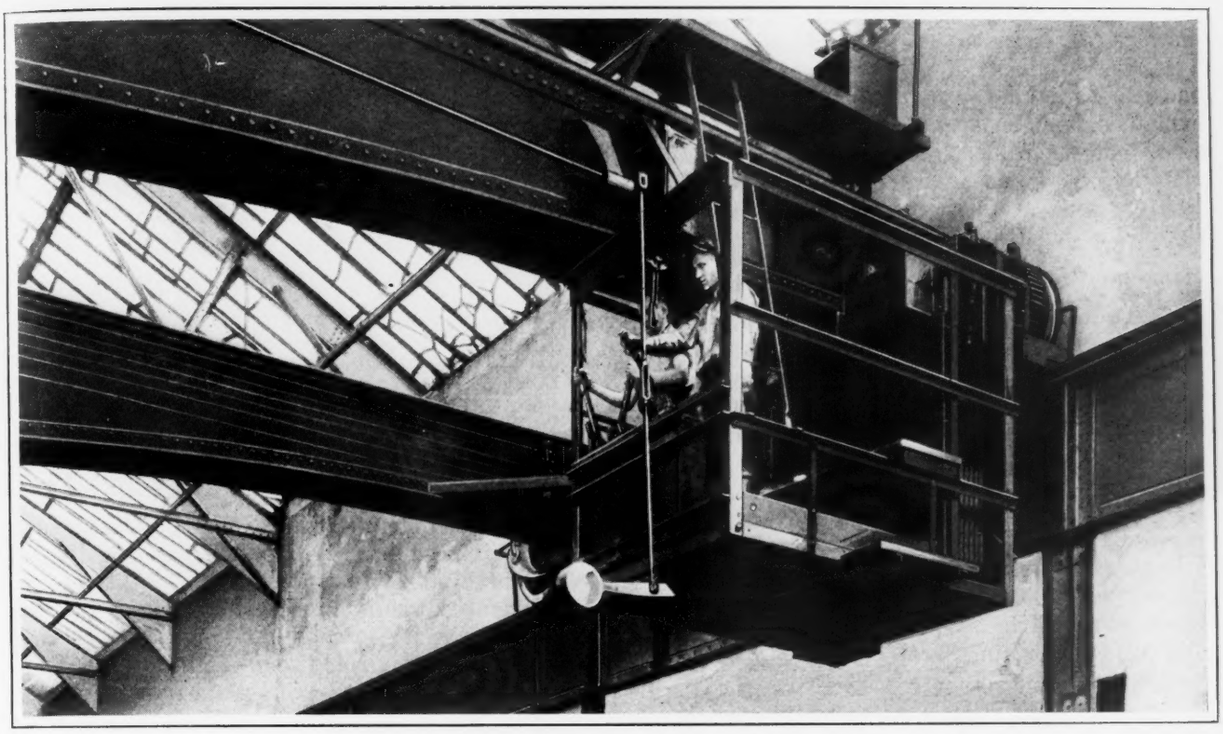


Fig. 15. Journal-box Set-screw Arranged to Prevent Oil Seepage

Resorting to the expedient of breaking capillarity at the joint, a groove *Z* may be cast in the cap and housing, as shown in view *D*, Fig. 11, and more clearly at *M* in Fig. 14. This groove extends without interruption from one end of the housing to the other, and the bottom is graded so that it will drain from the center toward both ends. A scheme of this kind is of considerable value in old installations, as it is comparatively easy to chip the groove, which does not have to be large, in the housing.

It is advisable for the groove in the cap to match that in the housing. The following is a desirable method of getting both grooves to align: The grooves should be first chipped in the housing and cords laid in them which have previously been smeared with red lead or Prussian blue. The cords should be large enough to project about one-half of their diameter above the surface of the split. By then bolting down the cap, the cords are forced against the under surface of the cap and clearly mark the desired locations of the cap grooves. On new parts made of cast iron, the grooves can be cored, but owing to the difficulty of making small cores in steel castings, it is usually preferable to chip them in such parts.

Before applying any of the means here outlined for preventing oil slinging or leakage, care should be taken to see that the shaft and bearing are in good running condition. For example, no amount of effort will stop oil-throwing in the main bearing of a reciprocating engine if a bad pound exists, or in a gear drive where the journal-box bore is worn badly out of round. It should not be imagined, however, that every bearing requires all the refinements outlined in this article in order to perform satisfactorily. An experienced engineer can tell from the conditions that the mechanism must meet in service just how much precautionary design is needed, and any refinements beyond that point may constitute bad engineering.



Hiring and Training of Crane Operators

A Brief Review of the Methods Used in the Westinghouse Plant to Secure Safe Operation of Overhead Cranes

By BENJAMIN HANTMAN, Assistant Superintendent, Light, Heat, and Electrical Equipment Maintenance Department, Westinghouse Electric & Mfg. Co.

THE widespread use of cranes for handling materials quickly, safely, and economically in industrial plants makes the hiring and training of crane operators an important function of any shop organization. Injury to workmen, slowing up of production, and damaging of materials may result from employing an operator physically or mentally below par, or from the improper training of an operator who otherwise meets all physical and mental requirements. The hiring and training of crane operators is, therefore, an important work in industry.

The Westinghouse Electric & Mfg. Co. has recognized this fact, and has adopted methods that have given very satisfactory results. The works organization is such that all crane operators are under the supervision of one foreman, who, in turn reports to the head of the Light, Heat, and Electrical Equipment Maintenance Department. This plan was considered to give better results than having the cranemen report to the foremen of the various sections where the cranes are located.

Great Care is Taken in Selecting Men for Operation of Cranes

Whenever any cranemen are required, the foreman makes out a form—"Advice of Workmen Required." This request, if approved by the assistant superintendent, is then sent to the employment department, which, after a preliminary interview with an applicant, sends him to the Light, Heat, and Electrical Equipment Maintenance Department for a further interview with the general foreman. If the applicant is accepted, notation of this fact is made on the form, which is then signed by the last interviewer, and returned with the applicant to the employment department.

The latter now sends the man to the medical department for a physical examination. This is given to all applicants who pass the interviews, no matter what their occupation or the nature of their work is to be. In the case of crane operators, however, a special examination is given which differs somewhat from the regular examination in that especial attention is given to sight, hearing, heart action, or any other physical defects that might militate against the safe operation of the cranes and thus be a source of hazard to the man himself or to his fellow workers.

The medical department, after making this examination, notes on the employment slip, class A, B, or C. Class A means that no physical or mental defects were found; class B, that the man may have some minor physical defects that would not necessarily interfere with the work in which he is to engage, or it may show some defect that can be remedied by the aid of artificial means, such as glasses. A man in the C class is one who would be a risk. Only men in the first two classes are considered for cranemen.

Assuming that the man passes the medical examination, he reports to the time clerk who assigns a number to him, giving him a brass check and a badge. The time system and other matters are explained, and he is given a book containing instructions for cranemen, hookers-on, crane repairmen, and workmen on crane runways. This book also contains sketches which illustrate standard signals for hoisting, lowering, etc.

How the Crane Operator is Trained for His Work

A number of years ago, an analysis was made of all the work in the shop, and it was divided into general classes based upon relative values. Approximately two hundred cranes, varying in capacity from two to fifty tons, are classified, in line with this system, into four classes; and the operators are paid accordingly.

If a crane operator has not had any previous experience, he is placed on the lowest rated crane with an experienced operator who is used for training purposes. For the first day or two, he does not make any lifts at all, but is allowed to become accustomed to riding in the crane and to become familiar with the lay-out of the floor, the nature of the work, and the various parts of the crane. He is then permitted to make lifts himself, with the instructor beside him. He is usually slow and cautious, and if the work falls back too much, the instructor, being the more speedy man, operates the crane until he catches up with the work.

During the first two weeks, the foreman and the assistant foreman come around at irregular intervals to see how the man is progressing. At the end of the two weeks' training period, the foreman or the assistant foreman rides in the cage with him for several hours and decides whether or not he is capable of running the crane by himself without any additional training.

If the operation is not satisfactory, the man is given further instruction until he has had enough experience. The last thing the foreman or the assistant foreman does is to have the operator read to him from the instruction book all the rules pertaining to crane operators, hookers-on, crane repairmen, and workmen on the crane runways, after which he is questioned to make sure that he is familiar with all the rules. His attention is also called to the same set of rules for cranemen posted in every crane cage.

Even if the new man has had previous experience, an experienced man is put in the crane with him. Of course, in that case, his training period is somewhat less than two weeks. He also receives a book of instructions, and is questioned about them in the same way as the beginner.

Promoting Men to More Responsible Work

The cranes in the higher classes are operated by men who are promoted from the next lower classes. The basis of selection is that, everything else being equal, the man with the longest service record is given the first opportunity. These men, however, do not always take advantage of this offer for various reasons; some, because they like the department in which they are working; others, because they are working over-time in their department, and believe their total pay would be larger in their present jobs.

There are both day and night shifts. The day men are under the supervision of a foreman and an assistant foreman, while the night force is under the supervision of an assistant foreman. The night shift is built up whenever possible by transferring the day men, and all men hired for the night force are given their training on the day shift. The night force receives a bonus.

Labor Turnover Among Crane Operators

Of all our cranemen, about 15 per cent have had at least ten years' service with the company, and about 5 per cent still longer service records; thus approximately 20 per cent of the total force are men of long experience. The ages of the operators range from 19 to 57, and average a little over 32.

Of the new men hired from the outside, three of the experienced men will quit to one of the inexperienced men; that is, the probability of the inexperienced man staying is three times as great as of the experienced man staying; further, a man transferred in the shop from another line of work to a crane will stay longer than a new man hired from the outside. As a whole, the labor turnover in the crane operating force is not much different from that in other lines of work.

Both day and night cranemen are examined once a year by the medical department. The results of this examination are noted on a form, which is made out in duplicate, one copy being filed with the man's record, and the other being sent to the foreman of the crane operators.

Providing for Emergencies

There are usually about five men who can run any of the cranes, and who act as spare operators or as instructors. There are also a number of men in other departments and on other occupations who have been trained to act as emergency crane operators. These emergency men are given some training which, while not so extensive as that of the regular operators, is sufficient for the purpose. They undergo the yearly medical examination and are given cards showing them to be competent cranemen.

From time to time the foreman of the crane operators or his assistant has some of these men go up on cranes and operate them so that they may keep in practice. The men who are transferred from crane operation to other work on the floor are sometimes called upon to take the place of a crane operator who may be absent, if there are not sufficient spare operators on hand. Such men also receive a yearly medical examination.

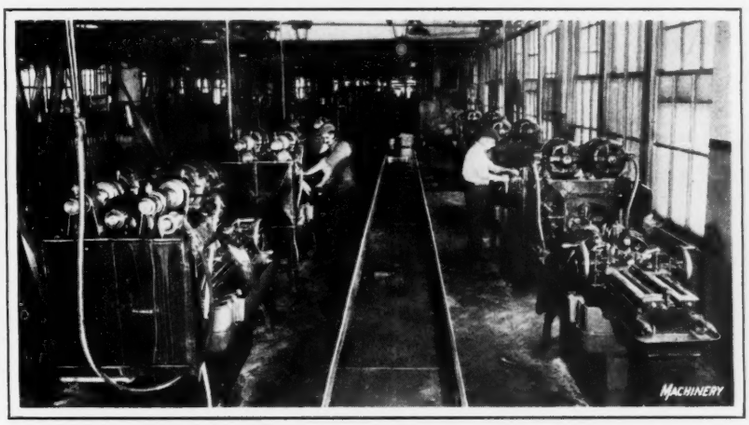
All regular operators are expected to keep their cranes clean and properly lubricated. When conditions are such that this cannot be done safely during regular working hours, it is done during part of the lunch period, the men receiving their over-time rate.

Complete understanding must exist between the crane operator and the hooker-on in order to do the work in the best possible manner. This is accomplished by occasional meetings of these men, at which their problems are discussed, recommendations made, and various hook-ups are illustrated.

Notes and Comment on Engineering Topics

Although automobile and bus traffic has taken a great deal of passenger revenue away from the railroads, the latter have considerably increased their passenger equipment in recent years. In 1911 there were 46,900 passenger train cars in service on the railroads in the United States, while in 1927 there were 53,800 such cars in service. The railroads have increased and improved their passenger-carrying capacity notwithstanding the competition that they now face.

Where the Colorado River flows through a canyon 400 feet deep and 600 feet across from lip to lip, at Marble Gorge, 130 miles north of Flagstaff, Ariz., bridge builders are now hastening to completion a steel structure that will link roads on both sides of the gorge and add greatly to the convenience of vehicular traffic traversing this scenic wonderland. The bridge will be 833 feet long, the main span being a cantilever arch of 618 feet. Structural materials and machinery had to be hauled over an unimproved road 130 miles long from Flagstaff. The bridge will completely change the present tourist routes.



Drilling Oil-holes in Connecting-rods at the Packard Motor Car Co.'s Plant, instead of Brazing Oil-tubes to Rod. This Change in Design Improves the Connecting-rod and Saves in the Production Cost. Note Chute in Center which Eliminates the Use of Trucks and Saves Floor Space

---

The field for the application of non-metallic gears varies all the way from the small gears used in speedometers and victrolas to those used in the paper industry having a face width of over 8 inches and a pitch diameter of 6 feet. In the steel mills, sugar refineries, railroad shops, textile mills, machine tool plants, mines, woodworking plants and printing plants, as well as in fare registers, speedometers, tachometers, magnetos, oscillographs—everywhere almost—one can find an application for non-metallic gearing material.

Tests were recently made by an English firm in which two samples of coal were subjected to the low-temperature distillation process. In the first case, the coal yielded thirty gallons of oil per ton, and in the second case, eighty one gallons per ton. Further refining of the product yields petrol, lubricating, illuminating, and other oils. On account of the simplicity of the process, the first cost of the plant and the production costs are said to be low. The residue available for use as smokeless fuel amounted to 68.8 per cent in the first case, and 52.1 per cent in the second.

The possibility of erecting a structural steel frame building silently by means of electric arc welding has often been emphasized by the advocates of this method. An interesting example of work of this kind carried out where silence is of great importance, has been called to our attention by the Lincoln Electric Co. A six-story, $250,000 addition to a hospital in Wheeling, W. Va., will be constructed by the arc welding method, as far as the erection in the field is concerned. The shop fabrication of the structural steel is of riveted construction; hence the building represents an intermediate design of steel structure, between the all-riveted construction and the all-welded construction. In making additions to office buildings, hospitals, hotels, telephone exchanges, department stores, and similar buildings, the welding method may prove of special value, because the work can be conducted by comparatively silent methods.

At the beginning of the war the annual world output of tungsten (60 per cent concentrates) was about 8000 metric tons. The war created an unprecedented demand for the metal for use in the manufacture of high-speed and other special steels, so that by 1918, the production reached 32,000 tons, a large part of this increased output being accounted for by China. During the post-war period the demand became normal, and production sank to the pre-war level. In 1925 the output took a jump, increasing to 14,000 tons of 60 per cent concentrates from an output of 6500 tons in the preceding year. On account of the uncertain political conditions in China, which possesses extensive deposits and, together with Burma, supplies the bulk of the world output, the leading consuming countries, Great Britain, United States, Germany, etc., are interested in possible new sources of supply, among which are the Transbaikal deposits in Siberia, which are now being exploited by the Soviet Republic.

Current Editorial Comment

In the Machine-building and Kindred Industries

PRODUCTION'S EFFECT ON WAGES

The real measure of wages is their purchasing power. The number of dollars in the pay envelope is in itself of little importance; the principal consideration is what those dollars will purchase of the necessities and comforts of life. Previous to the war, the cost of living was much less than now, but wages were much smaller, so that their actual purchasing power was much less than it is today. As compared with conditions previous to the war, the average working hours have been reduced about 10 per cent in our important industries, while the purchasing power of a week's wage has increased over 30 per cent.

This decrease in working hours and increase in the purchasing power of wages have been made possible by increased production. As wages are paid out of the money that the manufacturer obtains for goods produced and sold, and as more goods have been produced, it has been possible to increase wages and reduce working hours at the same time. Improved machinery, systems, and methods have made this increase in production possible.

The achievement of engineering in making possible such an increase in the purchasing power of wages should be recognized. Those who guide labor in its efforts to obtain better conditions may well consider whether this gradual upward trend, whereby the conditions of labor are steadily and peacefully improved, is not better than the means so frequently adopted in the past, whereby production was interrupted by strikes, and rules adopted that limited production and decreased efficiency.

Wasting Money on Worn Out Machines

The practice of wasting money on the repair of obsolete and worn out equipment frequently has been referred to in MACHINERY. Our attention was recently called to another striking example of this short-sighted policy. A manufacturer of boring-bars for reboring cylinders was asked by a customer to overhaul and repair some boring-bar equipment sold to him in 1883—forty-five years ago. It took a lot of figuring to show the customer that the scrap-heap was the place for his old outfit, but a new set of boring-bars is now operating to his advantage in the shop.

TOOL-ROOM BONUS SYSTEMS

The incentive to increased effort created by the premium or bonus system of wage payment has proved of great importance in quantity-production plants. When parts of the same kind pass through the shop day after day it is easy to determine what quantity a man may be expected to produce in an hour or a day, and to pay him a bonus for more than the predetermined quantity.

Until recently no satisfactory bonus system had been devised for the tool-room, because there the work changes constantly and no definite basis was found on which to figure the bonus. A few shops, however, have been working under bonus systems for toolmakers and have accomplished remarkable results. The leading article in this number of MACHINERY describes one such system and shows how, through its application, the toolmakers are able to earn more than formerly, while the cost of the tools of the company has been reduced. This result is caused by an increase of 40 per cent in the output of the tool-room since the bonus system was installed, without any increase in the number of toolmakers employed.

The manager of every machine shop having a fair-sized tool-room will doubtless find it profitable to investigate this application of the bonus system.

MOTION PICTURES FOR DEMONSTRATIONS

There is no sales argument more effective than a successful demonstration of a machine in actual operation; but it is not convenient usually to bring the machine to the prospective customer, or the customer to the machine.

The possibilities of motion pictures for demonstrating the action of new types of machines were recognized as soon as moving pictures had become successful for entertainment purposes, and one of their first uses was to show a machine for turning out 9.2 shells, exhibited by MACHINERY at the National Machine Tool Builders' convention in Cincinnati in 1917. But it required many years to develop the technique necessary for the making of good industrial motion pictures, and the cost of the films also prevented their general use for the demonstration and advertising of industrial equipment.

Advances made in the production of motion pictures within recent years have not only reduced the cost of making films, but greatly improved their quality; and "close-ups" can now be taken successfully that will show the action of a machine almost as clearly as if one saw the machine itself. The "slow" motion picture also shows the machine as if it were running at a much slower speed than it actually is, and demonstrates its action in a way that an inspection of the machine itself would not permit.

The value of motion pictures for demonstrating machines to a purchaser who might be a thousand miles away from the factory was well illustrated by the films shown at the last conventions of both the National Machine Tool Builders' Association and the American Society for Steel Treating. The educational value of motion pictures should also be emphasized, and their use in engineering schools and colleges should be encouraged.

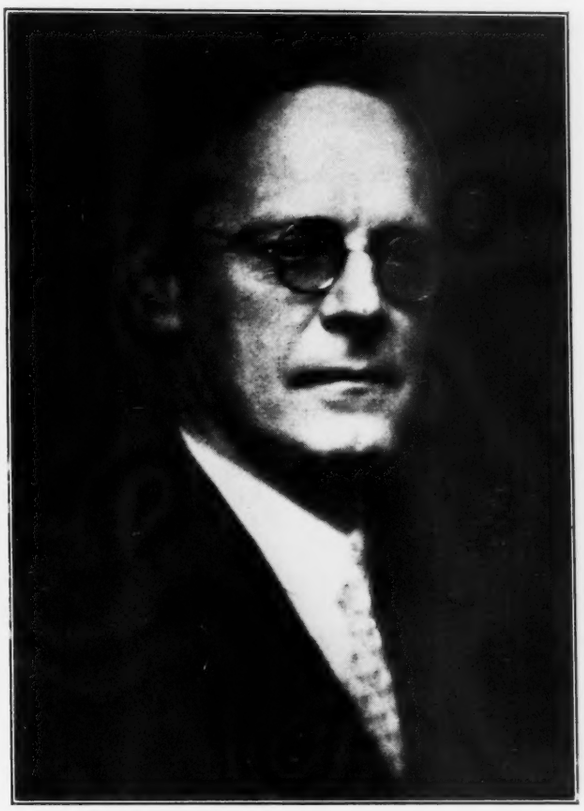
The Outlook for Commercial Aviation

The Present Status of Mail and Passenger Transportation by Air and the Problems That Still Remain to be Solved

By C. M. KEYS, President, Curtiss Aeroplane & Motor Co., Inc.; President, Transcontinental Air Transport, Inc.

TWENTY-FIVE years ago aviation was an inventor's dream; ten years ago it was a military weapon; today it is transportation. Of course, the inventors are still dreaming, and the armies and navies of the world are still spending millions of dollars in aviation development, but the primary purpose today is to reduce aviation to the peaceful uses of mankind—to transportation.

When flying was a specialty, whether in the inventive stage or in the military stage, it was intensely interesting to a few people, but when the combined minds of Europe, Asia, and America decided that it ought to be adopted as a means of carrying on commerce, it immediately became intensely interesting to hundreds of thousands of people instead of to a mere handful. That is the reason why in the United States it is possible to obtain unlimited capital for the development of commercial aviation and also to obtain what is more important —the interest and the active work of substantial and successful business executives. The result is that commercial aviation has now definitely become a business rather than an adventure. We no longer question whether aviation will become practicable as a means of transportation; we have passed that stage.



C. M. Keys
President Curtiss Aeroplane & Motor Co., Inc.

The best established part of commercial aviation today is the transportation of air mail. Each day the air mail planes of the country fly 25,000 miles or more, and of this flying more than one-third is done at night. There is no great risk involved in this operation. The routes of the National Air Transport, for instance, show approximately 3,500,000 miles flown, with the loss of three pilots and one ship load of mail. Up to the end of September this year, not a pound of mail had been lost or damaged on this line. The records also show that the cost of this transportation, including full depreciation and insurance, is low enough so that the service can be offered at a reasonable business price and at the same time show a reasonable profit.

On individual important trunk lines, such as the New York-Chicago line, for instance, the company carries the mail at an average of about 90 cents per pound, while the Government receives from the air stamps about $2 a pound. This is not true, of course, of the entire air mail system, because throughout the country as a whole, the rates charged by the transport companies have to be higher than on the New York-Chicago line, and on the very long lines, the cost of the transportation is in excess of the amount received by the Government for stamps.

It is a fact, however, that the entire air mail operation from the Government point of view is a much more business like operation than it was a few years ago. The trend of development of the transport companies has been constantly toward a lower cost per mile, and the average rates have tended steadily downward. The average of profits in the operation, from the standpoint of the carrier, has increased sharply as the volume of mail has increased.

This air mail operation is now an integral part of the business machinery of the country. It is used more and more extensively month by month. It is definitely here to stay and to be developed. There is no doubt in the minds that know this service best, that within a few years the great bulk of all the first-class mail traveling five hundred miles or more, will travel by air, mostly at night, and probably with a regularity not exceeded by that of any other form of transportation. This phase of air transport may, therefore, be considered a well established business enterprise.

The Problems of Passenger Transportation by Air

Passenger traffic by air is just as different from air mail traffic as passenger traffic by railroad is

different from the transportation of goods. In the first place, it is infinitely more expensive, largely because of the greater and greater demand for higher standards of safety. The transport of mail is nearly all in single-motored airplanes, while the transport of passengers tends more and more to employ multi-motored planes. There is also a demand for more and more comfort and more and more space. Not only do these demands bring a larger requirement for actual operating expenses, such as gasoline and oil and pilots' pay, but they also entail depreciation and obsolesence running three to four times that of the air mail planes, as well as terminal expense and expense for ground personnel and radio and telephone communication, and many other similar items, that is far beyond the expense of air mail traffic.

Passenger traffic in the United States has been carried on profitably here and there on short lines, using single-engined planes. On the long, important lines of the country, modern passenger traffic is just beginning to develop. In few, if any, cases has it shown a profit to date. Most of the pioneer lines now preparing to carry forward these experiments on a big scale have set up in their capital accounts heavy reserves for losses to be incurred in the first phases of the operation. Such losses occurred in the early days of the air-mail lines, and in fact such losses have occurred in the early days of almost all known forms of passenger transportation, by steamship, rail, bus, or electric lines. There is nothing unusual, therefore, in expecting the same to happen in air transportation.

Passenger traffic by air is just as different from air mail traffic as passenger traffic by railroad is different from the transportation of freight. In the first place, it is very much more expensive, largely because of the greater and greater demands for higher standards of safety. The transportation of mail is nearly all done by single-motored airplanes, while passenger traffic tends more and more to use multi-motored planes. There is also a constantly increasing demand for more and more comfort and more and more space. Then there is the greater expense for ground personnel, radio and telephone communication, and terminal expenses. All these expenses of passenger traffic are far beyond those required for ail mail traffic.

Successful Air Passenger Service Demands Better Facilities for Observing Weather Conditions

A more important and expensive adjunct of passenger service is the obtaining of adequate meteorological data and the bringing of this information to the command of the pilot instantly, in the plane itself. The United States Weather Bureau has expanded its meteorological facilities to meet the growing demand for such service, and the debt of the industry to this Government activity is gratefully acknowledged by all operators; but the Weather Bureau is not, and probably never will be, adequate to meet the requirements of well organized mail passenger lines of the country.

An intensive meteorological service along the entire right-of-way is a prerequisite to safety in passenger flying, and the expense of this service is one of the striking overhead items in the preparation of such a service for the public use. Not only must this information be obtained hour by hour while the planes are flying on schedule, but it must be transmitted to the pilots so as to obviate all danger of running into bad weather unexpectedly. This entails not only the collection of meteorological data on a definite right-of-way, but also the transmitting of this data along the ground and into the air where it will be used.

Commercial Possibilities of Air Passenger Service

This second phase of the transport business remains, therefore, still in the experimental stage. The sizable experiments that have been carried on so far appear to indicate quite clearly that the transportation of passengers in large planes will become a successful business.

The physical task of carrying on this flying is well in hand. The lines of the Western Air Express and of the Maddux Air Lines in California, furnished a local meteorological service through the cooperation of the Guggenheim Fund and the Weather Bureau, have operated successfully for months without material risk to property or passengers, but without substantial profits. The use of the lines has demonstrated that the public readily becomes educated to this form of transportation, and that rates per mile can be charged which might easily make the foundation of a successful business enterprise. It is, of course, obvious that once it is demonstrated that the public will travel and will pay a living rate to the carrier, this phase of the business will become very much the largest and most extensive department of air traffic.

Other Commercial Uses of Airplanes

The preceding paragraphs refer to organized transport lines. It is difficult to estimate closely the importance, or lack of importance, of individually operated airplanes that are run for profit. No definite statistics are available that show how many of these planes there are in operation, and it would be very difficult to draw the line between purely private planes and planes in commercial use throughout the country.

There are dozens of corporations, the largest of them with a capital in excess of $7,000,000, that operate planes for profit throughout the United States, but they do not operate transportation lines. Many of these companies operate training schools and there has been a very large demand for training all over the country. They also operate what are loosely called "taxi services" or "flying services," flying usually at a fixed rate per mile on any emergency service or for transportation in a hurry, seeking pleasure, going to football games, visiting friends, or merely exploring the upper reaches of the air, or sight-seeing around the big cities, the national parks, etc.

Nobody can estimate accurately how much flying for pay is carried on in these various pursuits. On a guess, I should be inclined to say that this phase of the business use of airplanes is bigger than all the organized transport flying combined, but it is hard to codify and impossible to analyze from a standpoint of profit or loss. As I have come in

contact with it personally, it has been profitable, and I think that on the average, throughout the country, the fact that it has constantly increased, and that the operating units have grown, would indicate that it is a profitable use of the airplane. This might be offset to some extent by the fact that it has not been practiced long enough to determine whether or not the operators charge themselves adequate depreciation on their equipment.

Adequate Airport Facilities Have Aided Rapid Growth of Aviation

A few years ago there were practically no airports in the United States, except those owned or controlled by the Government. Today there are hundreds of adequate air fields, some of them Governmental, some of them municipally owned, and many of them privately controlled. Statements have been made showing several hundreds of millions of dollars invested in airports. This is rather misleading, because I think that the great bulk of the airports of the country, particularly those that are privately owned, have been bought rather as investments in real estate, the owners of which merely expect the airport operation to help carry them for a few years, giving the owners an opportunity to realize increments of value from the advance in real estate, rather than from profits on airport operation.

Nevertheless, there is no doubt that this country has gone very far toward making the operation of airplanes both safe and profitable through the establishment of adequate ground facilities for their use. It has not been necessary for this growing industry to finance its own terminals to a very large extent. The transport companies and the individual operators, of course, pay rent at nearly all airports, provide their own hangar facilities, and incur many other items of capital and overhead expense, so that the industry is not in any sense the recipient of subsidy through these public and private investments. The provision of terminals in this way has, however, been much more rapid than it could possibly have been if the airplane industry itself had to provide this great investment.

Commercial Aviation is Still in its Infancy

From the foregoing one might conclude that commercial aviation has ceased to be an infant. I do not think that that is true; it is still hardly able to walk by itself. Wall Street has this year provided somewhat over $100,000,000 for commercial aviation, but the industry has barely begun to function. Perhaps a dozen of the larger companies have begun to show a profit, but none of them has reached a point where it can be said to have its capital structure completed, its facilities in working order, and to be ready to show substantial profits on its investment. The rapid expansion this year has been due to the ability of the leaders of the industry to get capital on reasonable terms. The immediate future of the industry lies in their ability to earn reasonable returns on this capital and to prove that the use of this new means of transportation is both safe and profitable.

Personally, I have no doubt of the ultimate answer, but, like most of the other men responsible to the public in this industry, I feel this responsibility as a very grave affair and one requiring not only most constant attention, but also a great deal of steadiness and conservatism.

* * *

MEETING OF AUTOMOTIVE ENGINEERS

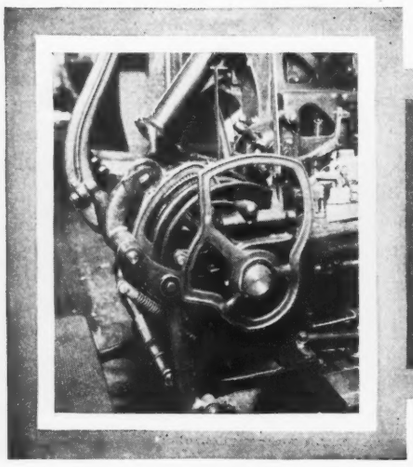
The annual meeting of the Society of Automotive Engineers was held in Detroit, January 15 to 18, with headquarters at the Book-Cadillac Hotel. Sessions were held relating to research, foreign automotive transportation, transmissions, fuels and lubrication, body design, engine research, chassis design, and production. At the production meeting the following papers were read: "Recent Developments in Chromium Plating," by M. F. Macaulay, engineer, Oakland Motor Car Co., and W. M. Phillips, General Motors Corporation's Research Laboratories; "Steels for the Automotive Industry," by T. McLean Jasper, director of research, A. O. Smith Corporation; "Recent Developments in Production Grinding," by B. H. Work, assistant chief engineer, The Carborundum Co.; and "High-velocity Penetration Devices," by Robert Temple. Copies of these papers may be obtained by those interested by addressing the Society of Automotive Engineers, 29 W. 39th St., New York City.

In the paper on chromium plating, the authors said that, since the successful plating of chromium on steel can be accomplished only after the part has first been plated with some other metal, such as copper or nickel, it was deemed proper first to present a brief summary of the advance made during the last ten years in the methods of plating with copper and nickel. Comparisons were made between the results obtained from manually operated plating tanks and semi-automatic and full automatic plating machines.

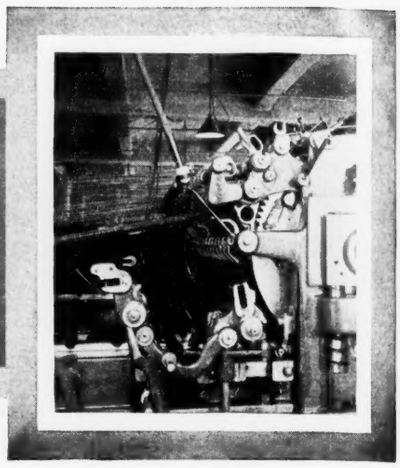
The authors then proceeded to outline the best methods for chromium plating, giving directions in considerable detail. Proper polishing was emphasized as the secret of successful plating, because the ultimate finish is no better than the finish on the base metal. It was mentioned that one large company presses parts from highly polished steel, keeping the dies in such condition that no polishing is required after forming the piece. This eliminates a great deal of the polishing cost.

Welded Machine Bases

A great deal of thought is being given at the present time to the substitution of welded machine frames and bases for those made from cast iron. In an article on this subject in March MACHINERY, J. L. Brown, mechanical engineer of the Westinghouse Electric & Mfg. Co., will outline some of the methods being used at the present time in designing welded steel bases. In some cases, the welded frame has not reached the satisfactory appearance of the cast frame, while in other instances, most remarkable results have been obtained by proper care in suiting the design to the new method of construction. As more study is given to this subject, there is no doubt that the matter of appearance, which has been much discussed, can be taken care of in a satisfactory manner.



Ingenious Mechanical Movements



GENEVA MOTION DESIGNED FOR SLIGHT OVER-TRAVEL

By ORVAR BONANDER

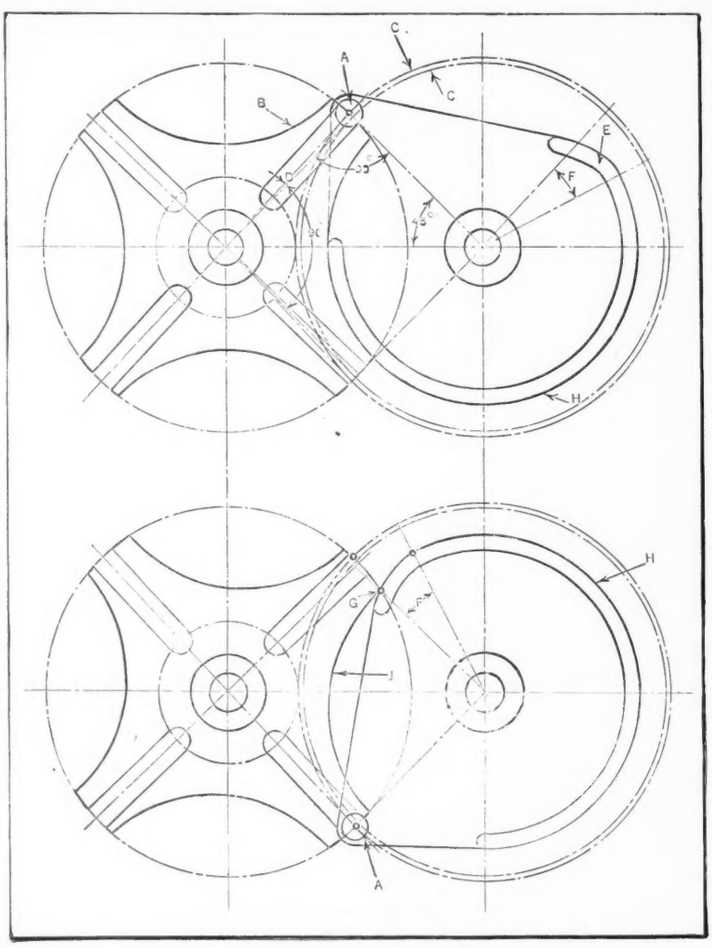
An ingenious special Geneva motion was developed to operate the conveyor of an automatic weighing machine. This conveyor, by means of brackets attached to it, pushes the packages to be weighed on the scale platforms of the machine and then stops and remains stationary while the weighing takes place.

Originally, this conveyor was operated by an ordinary Geneva motion, but the packages sometimes rubbed against the conveyor brackets, which seriously affected the accuracy of the weighing. To prevent this, it was necessary to have the conveyor moved back about 1/8 inch after delivering the packages to the scale platforms, thus providing clearance between the conveyor brackets and the packages. This clearance has been obtained by a slight change in the Geneva motion, the result being that the conveyor is first given a small amount of over-travel and is then withdrawn a distance equal to this over-travel, thus providing the clearance desired.

The over-travel has been obtained by enlarging the diameter of the path traversed by the driving roller *A* (see accompanying illustration). Circle *C* represents the normal path described by the center of roller *A*, or the radial position of the roller when the movement of driven wheel *B* is 90 degrees during each roller engagement. By increasing the diameter of this path, as represented by circle C_1, driven wheel *B* and the conveyor are given the required amount of over-travel. The center lines of the slots in wheel *B* are approximately tangent to circle C_1, so that engagement takes place without shock and the mechanism operates smoothly. Angle *D* is equivalent to one-half of the angular over-travel imparted to wheel *B*.

When roller *A* reaches the position shown by the lower view, it has moved wheel *B* 90 degrees plus twice the angle *D*. Now as the roller leaves its slot, cam surface *E*, which extends through angle *F*, comes into contact with corner *G* of the slotted wheel and pushes the wheel back an amount equal to twice the angle *D*, thus withdrawing the conveyor brackets from the packages during the time required for weighing. The driven wheel is locked during this dwell by the engagement of concentric surface *H* with arc *J* on the driven wheel, the wheel being released as soon as roller *A* again moves around into engagement with a slot, or in the position indicated by the upper view.

This simple method of preventing frictional resistance between the con-



Special Geneva Motion which Gives Slight Over-travel and Equal Return Movement to Provide Clearance

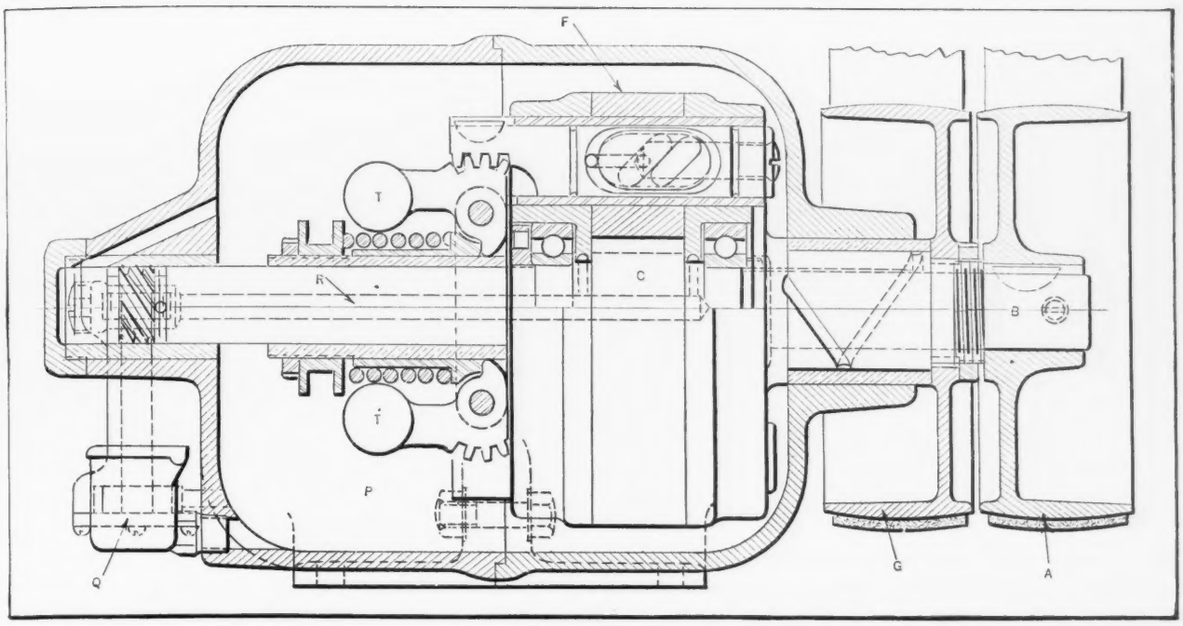


Fig. 1. Hydraulically Controlled Transmission which May be Used either as a Clutch or for Varying Speeds

veyor brackets and packages during the weighing operation did not introduce any difficulties in manufacturing the intermittent motion described.

* * *

HYDRAULIC TRANSMISSION

By HARPER A. GOOD

The hydraulic transmission illustrated by Figs. 1 and 2 is so designed that the speed of the driven pulley may be varied from zero up to the full speed of the driving pulley, so that this mechanism may be utilized as a clutch or for changing speeds.

The driving pulley *A* on shaft *B* (Fig. 1) revolves gear *C* and two idler gears *D* and *E* (see Fig. 2). These idler gears are housed in case *F* to which the driven pulley *G* is attached. The gears referred to act as a pump, and circulate oil through ports *H*, *J*, *K*, and *L* (as indicated by the arrows), provided the ports in the cylindrical or plug valves *M* and *N* are open.

If valves *M* and *N* are fully open, the gears will rotate freely, because the oil can circulate through the passageways without resistance; consequently, the driven member and its pulley will remain stationary. If, however, the valves *M* and *N* are closed gradually, there will be a corresponding increase in resistance to the rotation of the gearing, and as a result, the driven member will rotate at a rate of speed depending upon the amount of resistance. When valves *M* and *N* are completely closed, all rotation of the gears is prevented, and the driving and driven members rotate at the same speed. The transmission then acts like a clutch in engagement, whereas when valves *M* and *N* are fully open and the driven member is stationary, the action is similar to a clutch that has been disengaged. Thus it will be seen that the gears revolve as a unit only when the valves are fully closed, and they rotate about their axes when the valves are partially or entirely open for the purpose either of varying the speed or discontinuing the drive entirely.

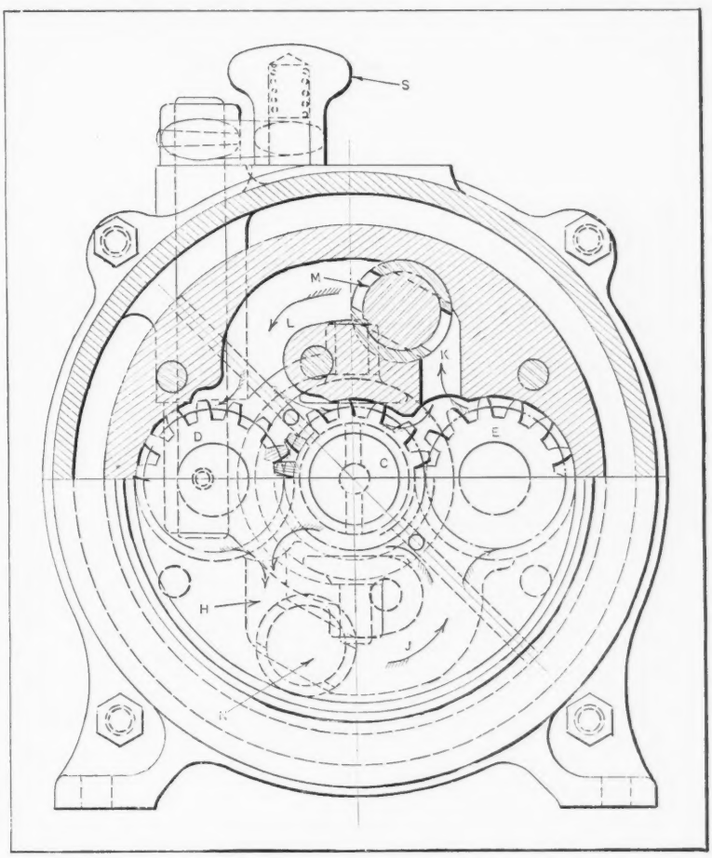


Fig. 2. Cross-section, Showing Gears and Control Valves of Hydraulic Transmission

The main supply of oil is in the main casing at *P* (Fig. 1) and a small pump at *Q*, driven through spiral gearing from the main shaft, forces the oil through a central opening *R* in this shaft. Lever *S* (Fig. 2) serves to control

the positions of valves *M* and *N* and the speed variations. Any variation in the speed for which the mechanism is set, caused by changes in load, is regulated by the centrifugal governor *T* (Fig. 1).

In order to relieve the oil pressure at the points where the teeth of gears *C*, *D*, and *E* intermesh, small radial holes are drilled through these teeth and connect with diagonal holes leading to the spaces between the teeth, thus relieving the oil pressure and lessening friction. This transmission is also designed to provide reversal by special arrangement of gearing connecting with the driven member. The hydraulic feature of the transmission, however, is the same as described.

* * *

ADJUSTABLE DOUBLE-MOTION ECCENTRICS

By HERBERT A. FREEMAN

The diagram Fig. 1 represents a disk at *A* encircled by a strap in which the disk is free to run. If this disk is mounted on a concentric shaft perpendicular to it, no motion will be imparted to the strap. However, if the shaft passes through the geometrical center of the disk, but the disk is located at some angle *a* (see diagram *B*), then as the shaft makes one complete revolution, the disk and its strap will oscillate harmonically through angle 2*a* in a direction parallel to the shaft.

Referring now to diagram *C*, two eccentrics are shown in outline, each having an eccentricity equal to *e*. The outer eccentric is adjustable relative to the inner one, and it is assumed that they can be fastened in any angular relation to each other. When clamped in the position shown, one eccentric offsets the other, so that the resultant throw is zero. When the positions are changed, as shown by diagram *D*, the eccentricities are added, and intermediate positions will, of course, vary the throw from zero to 2*e*.

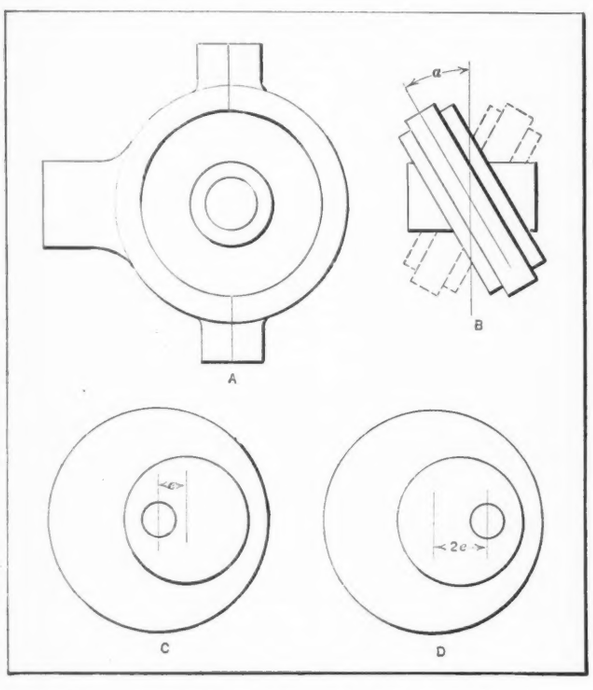


Fig. 1. Diagrams Showing Principles Combined in Eccentric Illustrated in Fig. 2

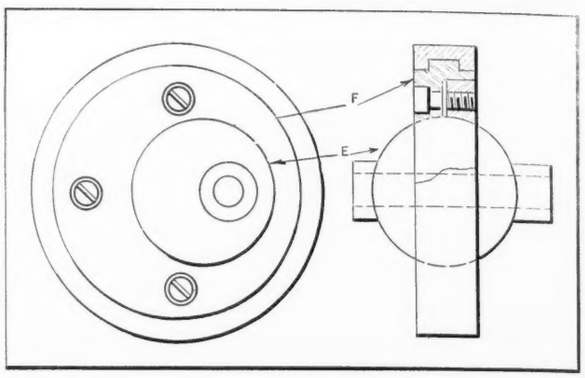


Fig. 2. Eccentric Adjustable as to Throw and Angle Relative to Shaft

Fig. 2 illustrates how the principles shown separately in Fig. 1 are combined. The inner eccentric *E* is made spherical, so that the outer eccentric *F* may be set at an angle to the shaft, as indicated by diagram *B*, Fig. 1. These inner and outer eccentrics, Fig. 2, have the same eccentricity, so that any throw from zero up to the maximum may be secured by adjustment, as represented by diagrams *C* and *D*, Fig. 1. Finally, the mechanism as a whole may be arranged for a circumferential adjustment about the shaft. This mechanism or some modification embodying the same principle may be used to obtain a harmonic motion in perpendicular planes with adjustment as to amplitude and phase.

* * *

WORLD ENGINEERING CONGRESS IN JAPAN

The World Engineering Congress to be held in Japan during the fall of 1929 will open Tuesday, October 29, and close November 7, in Tokio. The Congress will be held under the auspices of the twelve leading technical societies of Japan, and is being liberally supported by the Japanese Government. Much of the organization work is in the hands of Baron Shiba, while the chairman of the organization committee is Dr. Masawo Kamo of the Tokio Imperial University, who is well known in engineering circles in the United States and who presented an invitation to attend the Engineering Congress at the annual meeting of the American Society of Mechanical Engineers in New York in December.

The whole engineering profession and the Japanese industry are cooperating to make the Congress a success. It is expected that about 250 official delegates from the United States will be present. In addition to the technical sessions, a program of excursions has been planned, on which some of the remarkable evidences of Japanese engineering progress will be inspected. We have been informed that free transportation will be furnished visiting delegates on the Japanese railways.

* * *

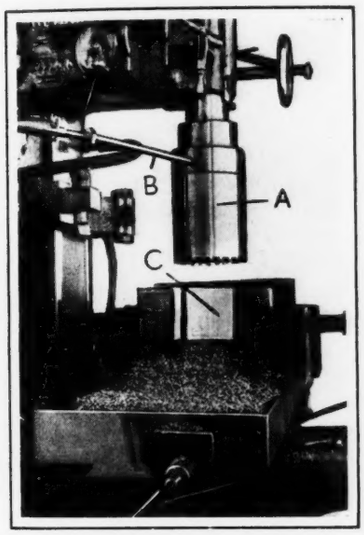
Imports of industrial machinery into Germany during the first nine months of 1928 exceeded those of the corresponding period of 1927 by over 20 per cent. The total value of the imported machinery in the first nine months of 1928 amounted to $19,150,000. Of this, $2,685,000 represented metalworking machinery.

Special Tools for Railway Shops

TIME-SAVING TREPANNING TOOL

By J. B. IRWIN, Shop Superintendent, Chicago, Burlington & Quincy Railroad Co.

A trepanning tool that has proved a remarkable time-saver on various jobs handled in a locomotive shop is shown in the accompanying illustration. It consists of a hollow-bored body *A* having tool-steel teeth inserted in the lower edge, as shown in the illustration. The pipe shown at *B* conducts the lubricant to the cutter through the hollow-bored body.



Trepanning Tool Capable of Boring a 10-inch Hole through an 8-inch Billet in Twenty Minutes

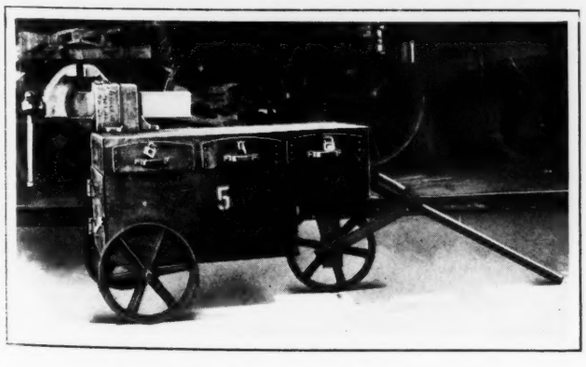
This trepanning tool has proved particularly effective on locomotive rod work, in some cases reducing the machining time from one-fifth to one-eighth that required by former methods. The illustration shows the cutter and work after a crescent-shaped piece of metal has been removed from the front end of the fork of the back-end main-rod floating bushing adapter *C*.

In cutting out a crescent, the chips will take care of themselves, but in cutting a complete circle from the solid, three holes, 1 1/8 inches in diameter, should be drilled through the piece to permit the chips to escape. The washing action of the lubricant prevents the cutter from being clogged by chips.

PORTABLE WORK-BENCH

By H. H. HENSON, Foreman Machine and Erecting Shop, Southern Railway Co.

A portable work-bench with a vise attached, as shown in the accompanying illustration, has proved a great convenience in the engine room of a railroad shop. Being portable, it can be moved by the mechanic and his helper to any part of the shop to which their work may call them.



Portable Work-bench with Vise Attached

The bench contains four different sizes of tool compartments, giving sufficient space to accommodate the size and kind of tools needed on most engine house jobs. It is constructed largely of boiler plate. A valuable feature of portable benches is the elimination of the corners formed by fixed benches, into which old scrap parts are frequently thrown or stored.

TURNING BALL JOINTS ON LOCOMOTIVE EXHAUST PIPES

By J. H. HAHN

In Fig. 2 is shown an attachment for turning ball joints on receiver and final exhaust pipes for

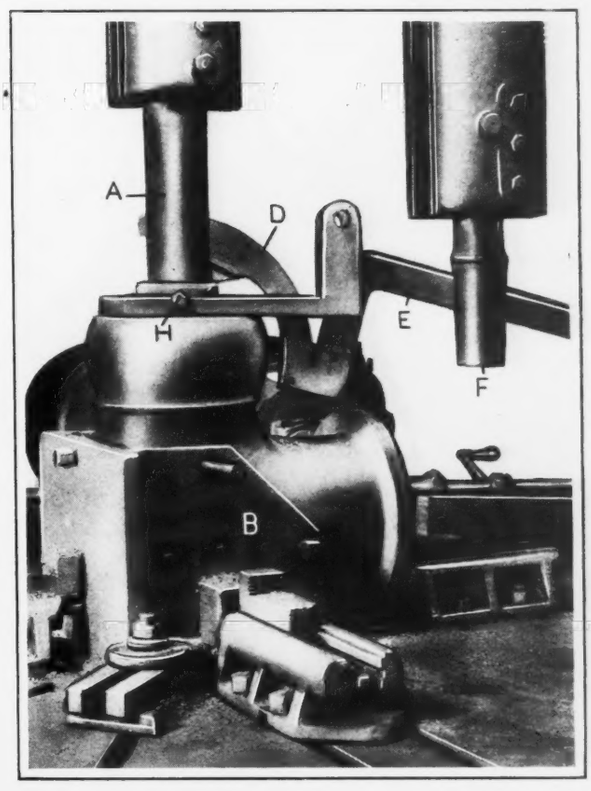


Fig. 1. Turning Ball Joint on Exhaust Pipe Fitting

Mallet compound locomotives. The attachment is employed on a boring mill as shown in Fig. 1. The use of this attachment has resulted in reducing the machining time and in producing accurate ball or spherical joint surfaces.

As shown in Fig. 1, the casting to be machined is set up in a box type fixture *B*. This fixture is located on the boring mill table with the bar *A*, the center of the boring table, and the center of the ball joint to be turned in accurate alignment. The bar *D* which carries the turning tool is held in the spindle in the head mounted on the left-hand side

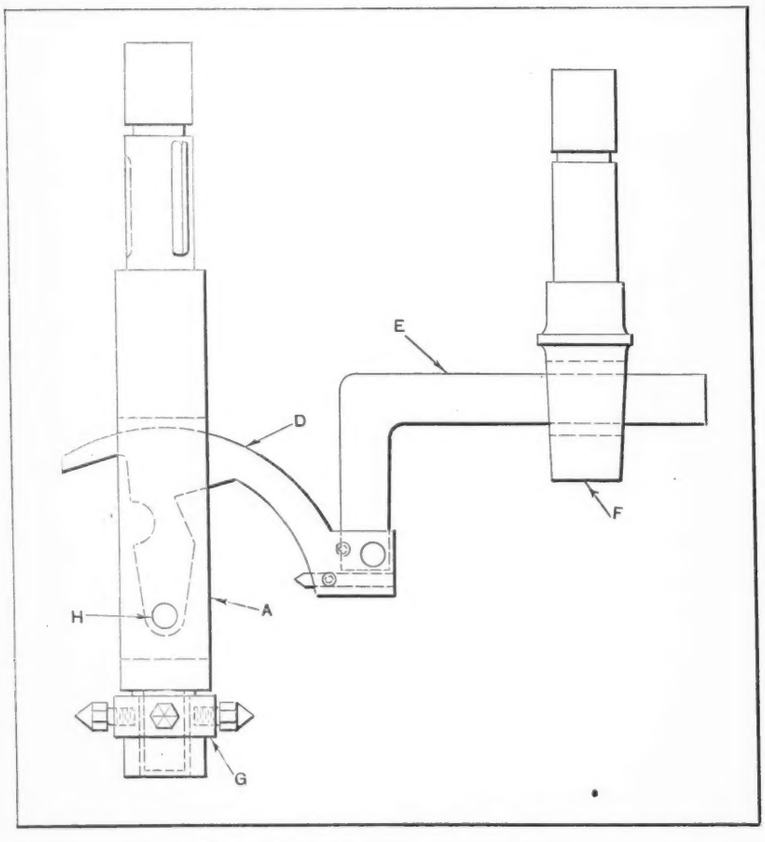


Fig. 2. Ball Joint Turning Attachment

of the cross-rail. The arm *E* which controls the feed is passed through a slot in bar *F* of the head at the right-hand side of the cross-rail.

The lower end of bar *A* is centered and supported in the work by the adjustable spider *G* shown in Fig. 2. The bar *F*, Fig. 1, which is slotted to receive the arm *E*, is an old discarded piston-rod turned down to fit the head of the boring mill. The lever *E* is pivoted about the stud *H* to give the feed required for turning the spherical joint by raising or lowering the bar *F*. The vertical feed for bar *F* is obtained by employing the power feed.

CHUCK USED IN BORING WASHERS FOR RAILWAY USE

By E. A. LOTZ, Shop Foreman, Pennsylvania Railroad Co.

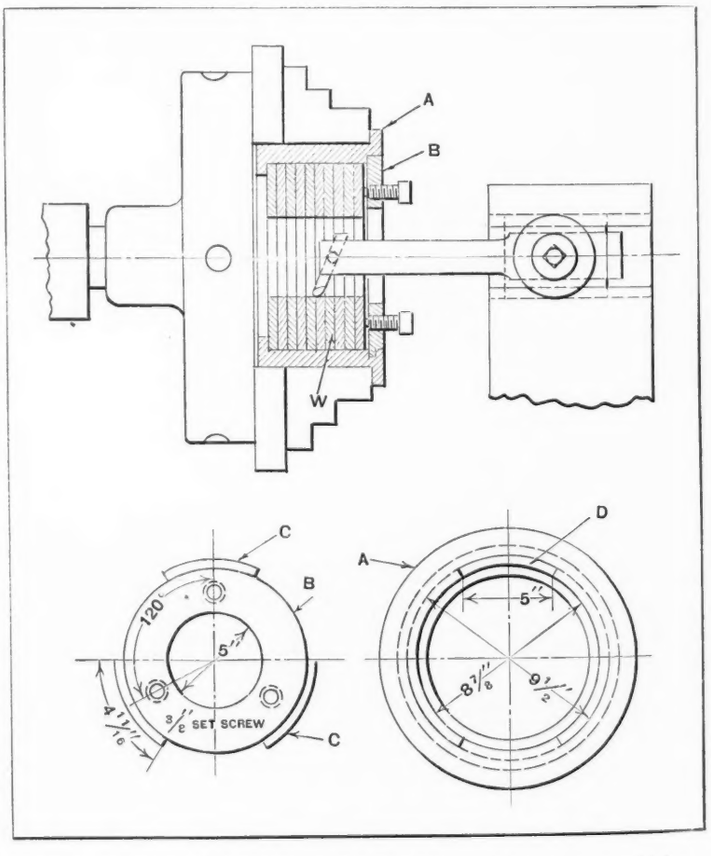
A quick-loading chuck for use in drilling or boring out washers previous to turning the outer edges and surface-grinding the faces is shown in the accompanying illustration. The holder *A* is made up of a scrapped locomotive side-rod bushing, while the clamping head *B* is made from a piece of scrap boiler plate. The washers *W* are firmly held in position by the clamping head *B*, which is applied by inserting it in member *A* and turning it so that the three extended portions are directly under the three flanges in the holder *A*. The extended portions *C* of member *B* are shown in the plan view in the lower left-hand corner of the illustration, and the cut away portions *D* of member *A* in the right-hand corner.

After being bored, the washers are placed on a large mandrel with spacers between, which permit the outside edge of each washer to be formed to the correct radius after being turned to the required diameter. Following this operation, the washers are ground to the required thickness on a surface grinder.

* * *

CONVEYING SYSTEM AIDS PRODUCTION

The effect that a conveying system may have on production is shown in a plant manufacturing dry cell batteries. In this plant, the operators moved the dry cells on trucks from one machine to another. The output under these conditions was 36,000 dry cells in a nine-hour day. A modern conveying system was installed, and with the same floor space and approximately 6 per cent fewer operators, the output was increased to 65,000 dry cells per day. The increased production was due, first, to the fact that the conveyors set the pace and all the workers had to follow, and, second, that the operators did nothing but productive work, the time formerly used for moving the material being completely saved.



Chuck Used to Hold Washers while Boring or Drilling Center Holes

LEATHER PULLEY COVERING

By E. PERRY

Pulley covering differs from regular leather belting in several ways: Primarily, the leather is not so carefully selected; culled butts, belly pieces, and split shoulder stock are considered good enough for such material.

The purpose in using leather on the face of the pulley is to increase the pulling friction and prevent the belt from slipping; consequently, the leather must be properly tanned and curried, be free from holes and cuts or other defects, and should be fairly waterproof. Otherwise, the specification for leather pulley covering can be liberal, provided the material will pass the specified physical requirements. Restrictions need not be placed on the kind of tannage used, nor on the use of leather from different parts of the hide.

Laps or Splices

Stock for pulley covering should be cut lengthwise of the hide to insure proper length, so that there will not be more than one lap on a large pulley. The laps should not be over 6 inches nor less than 3 inches in length, and should be properly scarfed and cemented in such manner that no separation of the lap will occur if the stitching breaks. Stitching is preferred to riveting, and should extend fully an inch past each end of the lap and be locked to prevent raveling.

A "lock-stitch" instead of the common chain-stitch is desirable, and there should be about three and one-half to four and one-half stitches to the lineal inch. The thread used for stitching may be either linen or cotton; the former is stronger on a straight pull, but the latter is best for flexure. The size of the thread generally used is known as 24-20.

The number of rows of stitches in the lap depends upon the width of the belt, but it is customary to have the two outside rows 1/4 or 1/2 inch from the edge of the belt and allow a space of 1 to 1 1/2 inches for the inner rows. Pulley covering is made the same width as the pulley, and usually is wider than the belt which runs on the pulley.

Pulley covering 2 1/4 to 3 1/4 inches in width should have two rows of stitching in the lap; sizes 3 3/4 to 4 1/4 inches require three rows of stitches; 4 3/4 to 5 1/4 widths, three or four rows; 5 3/4 to 6 1/4 inches, four or five rows; and sizes up to 12 inches in width, not less than six rows of stitching.

Tensile Strength and Thickness

The strength of pulley covering is but little less than that of strong belting leather, but the stretch, especially where belly pieces are used, is nearly twice as great. Strength and thickness are the only points to be considered in this material, the thickness having a direct relationship to the strength. Preferably, the leather should not be less than 0.12 nor more than 0.25 inch in thickness, and should have a tensile strength of not less than 4000 pounds per square inch, or the equivalent of about 500 pounds per inch of width for leather 1/8 inch thick.

Bending Test

The pliability of the leather is determined by a bending test. A piece of leather not less than 6 inches long must withstand being bent flat upon itself—grain side in—without showing any evidence of fracture on the outside, or flesh side, of the bend.

Another similar piece folded flat upon itself—flesh side in—must not show a continuous break or large open cracks on the outer or grain side, and on rebending in the reverse direction must not show a distinct break on the flesh side. Good pulley covering will meet all these requirements, whereas brittle leather and that containing hard uneven spots will not withstand the bending test.

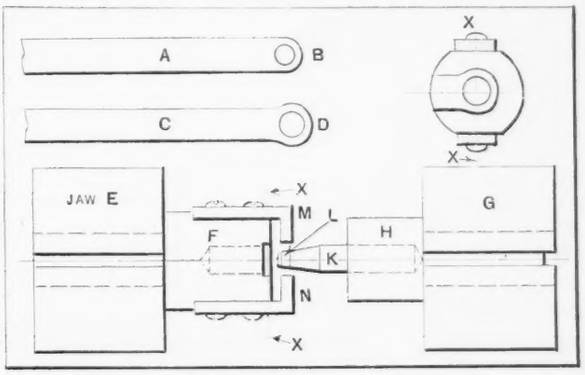
Pulley covering should be rejected for physical defects such as holes and cuts, improper cementing and stitching, ununiform thickness when thinner or thicker than specified, and when "spongy" or deficient in strength.

* * *

ENLARGING HOLES WITH A BUTT-WELDER

By H. C. TEN HORN

In a large quantity of wrought-iron pieces, as shown at *A* in the accompanying illustration, the hole *B* had to be enlarged to the size shown in piece *C* at *D*. At the same time the end had to be kept rounded as shown. This operation can be done in different ways; one way is to heat the part *A* and then forge it in a suitable die. However, the writer decided to do this job in a butt-welding machine



Dies Used in a Butt-welding Machine for Enlarging the Hole Shown at B in Piece A to Size Shown at D in Piece C

which enabled first-class work to be done at a very low production cost.

The method employed was as follows: In the jaw *E* a special copper die was clamped, as shown. In the other jaw *G*, die *H* was clamped. A hole was drilled in die *H* to the proper size to fit a steel mandrel *K*. This mandrel, which has to enlarge the hole in the work, has a pilot *L* that fits hole *B*. The operator handles the job as follows: Piece *A* is held in die *F*, and mandrel *K* is pushed to the left till pilot *L* enters the hole in *A* and the tapered part of the mandrel bears against the edges of the hole. The current is now turned on until the work is heated sufficiently, and then the jaws *E* and *F* are brought forward until *A* is pushed over the straight section of *K*, thus enlarging the hole to the proper size. At this time the current is switched off and the jaws moved in the opposite direction. Piece *A* is stripped off by the stripper plates shown at *M* and *N*. The complete operation lasts only a few seconds.

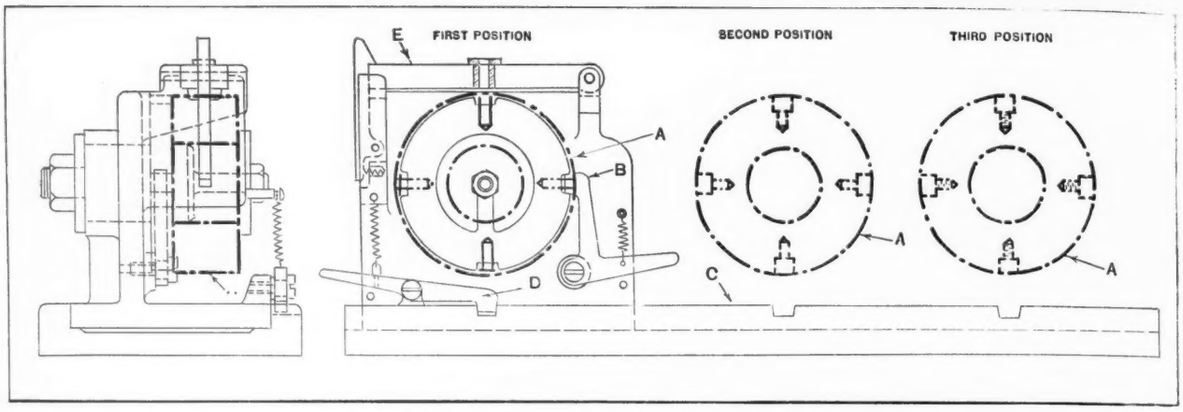


Fig. 1. Three-position Indexing Type of Drill Jig

Multiple-spindle Drill Jigs

By S. J. HELWEG

IN the average manufacturing plant are found many jobs tooled up for single-spindle drilling that could be drilled more economically with a multiple-spindle head or a multiple-spindle drill press. If you should ask why these jobs are handled in the old-fashioned way, the answer would doubtless be that a new multiple-spindle drill press would cost too much or that the machine then in use would otherwise stand idle most of the time. It does not, however, require many jobs of some kinds to permit the multiple-spindle drill press to pay for itself, and the chances are that it would pay to sell or even scrap the old machine and buy new equipment better fitted for the job.

When multiple-spindle drilling is proposed, the first thing to do is to analyze the job properly to determine what type of multiple-spindle drilling equipment should be used. The various drilling methods should be classified as follows: Drilling with ordinary drill presses having several fixed spindles; with specially designed multiple-spindle drill heads used in the ordinary drill press; or with a multiple-spindle drill press having several adjustable spindles.

If the work is drilled from various angles, tapped, or counterbored, etc., then the ordinary drill press should be used. If production is large enough to keep the job going day after day, the drilling head may be used to best advantage. If there are many holes to be drilled, however, and these holes are fairly uniform in size, the adjustable multiple-spindle drill press should be employed, provided there are several jobs that can be tooled up for this machine, which will keep it in continuous operation.

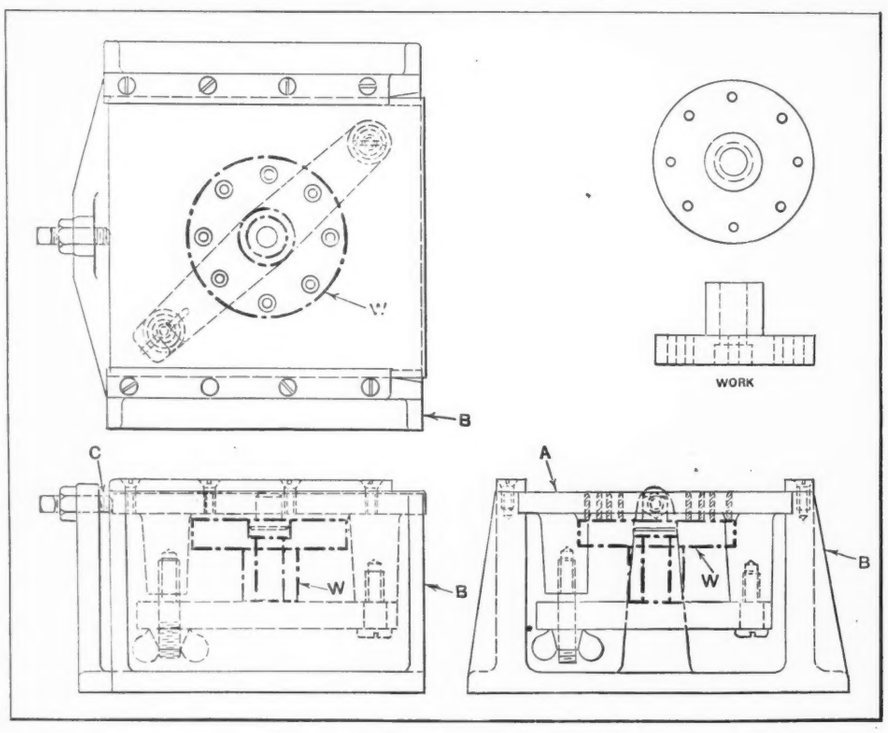


Fig. 2. Load-and-Drill Type of Jig

Drilling, Counterboring, and Tapping on Four Sides

In Fig. 1 is shown at *A*, a part that is drilled, counterbored, and tapped from four sides. This job should be handled on a drill press with three fixed spindles. The drill jig has a bushing leaf *E* and a pawl *B* for indexing the work to the four positions for drilling. The jig is mounted on a guide base *C*, fastened to the drill press table, and is positioned underneath each spindle by a latch *D* which engages the slots in the base. The holes are first drilled with the jig in the first position. The bushing leaf *E* is then opened, the jig moved to the second position, and the holes counterbored. In the third position the holes are tapped.

If the multiple-spindle drill head is to be used, this can either be designed and built right in the factory, or a standard head can be bought and fitted to a regular drill press. Several good multiple-spindle tapping heads are also on the market.

In designing drill jigs for the adjustable multiple-spindle drill press, due consideration should be given to the accuracy required and to the time allowed for drilling. If the drilling must be done very accurately, bushings should be used to guide the drills, but if the drills are large and the spacing of the holes not very important, then the bushings may be left out. If the time for drilling each piece is long enough to warrant it, two jigs should be used, so that one can be cleaned and loaded while the other is being used for drilling.

Load-and-Drill Method

In Fig. 2 is shown a jig of the load-and-drill type. The work *W* is a cast-iron flange through which several bolt holes are to be drilled. The jig slide *A*, with the work in place, is pushed into the stand *B* against the stop *C*. The stand is fastened to the drill press table. For a job of this kind, two sliding jig plates *A* should be used, so that one can be cleaned and loaded while the other is in the jig. The same type of stand can be used for drilling wood boards or metal plates where no great accuracy is required. For such work, the slide is omitted and the stand is fitted to take the work itself.

Using Separate Bushing Plates

Another jig, similar in construction to the one in Fig. 2, is shown in Fig. 3, the principal difference being that the work *W* is of such a shape that it can be guided in the stand, and the bushing plate *A* located on, and clamped to, the work.

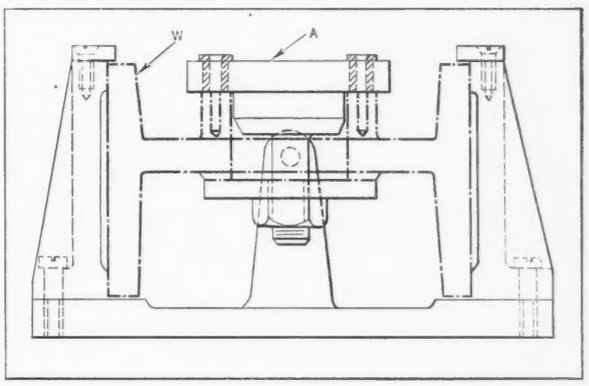


Fig. 3. Drill Jig with Separate Bushing Plate

Jigs for Heavy Work

In Fig. 4 is shown a jig used in drilling a rather large casting *W*. Here the bushing plate *A* is swung open, or removed entirely and the work is located and clamped to the base *B*. This type of fixture can be used for heavy work, where it takes considerable time to load the jig and a comparatively short time to do the actual drilling, in which case the use of two jigs would not be profitable.

Drill jigs will, of course, vary in shape and construction to suit each particular job, but the types of jigs here illustrated and described represent designs that can be easily adapted to multiple-spindle drilling machines.

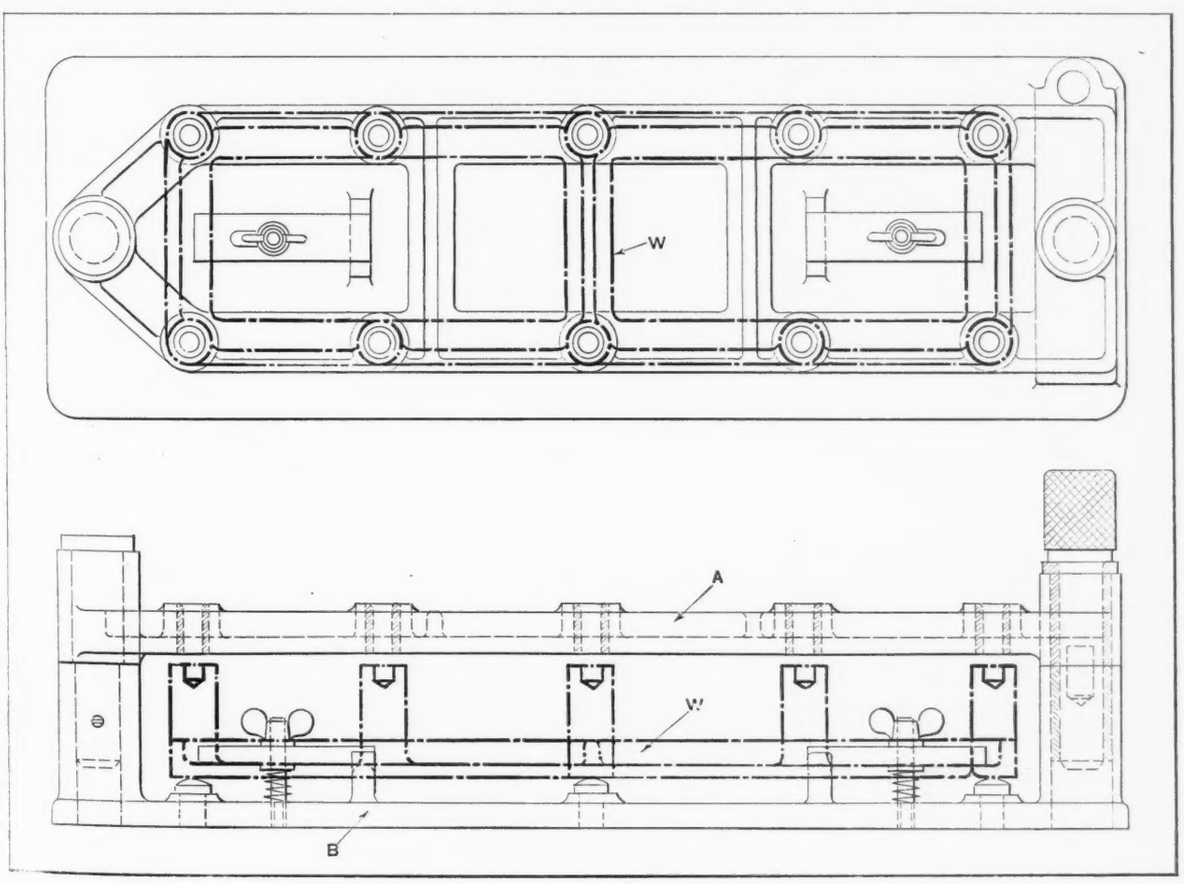


Fig. 4. Drill Jig Suitable for Heavy Work

Chromium Plating for Wear Resistance*

A Review of Present-day Applications of Chromium Plating to Drawing, Forming, and Blanking Dies, Metal Cutting Tools and Machine Parts

By W. BLUM, Chemist, Bureau of Standards, Washington, D. C.

IN January MACHINERY, page 355, the subject of chromium plating for wear resistance was dealt with as it refers to chromium-plated measuring tools, particularly plug, ring, and snap gages, as well as thread gages. The hardness of the chromium plate, the adherence of chromium to the object plated, and the thickness of deposit on chromium-plated gages were among the subjects discussed in the previous number. In the present article, the application of chromium plating to drawing, forming, stamping, molding, and blanking dies will be referred to; the value of chromium plate on tools for cutting metals will be dealt with; and the wear-resisting properties of chromium-plated machine parts subjected to severe wear will be covered.

Chromium-plated Tube and Wire Drawing Dies

The information available on chromium-plated drawing dies for tube and wire drawing shows an apparent contradiction in that dies and mandrels used for tube drawing are generally reported as satisfactory (with but one exception), while wire-drawing dies are usually unsatisfactory. The latter are reported as failing through flaking or peeling of the chromium, and subsequent scratching of the wire. The only obvious explanation of this discrepancy is that the apertures in the wire dies are usually much smaller and therefore more difficult to plate uniformly than those in the tube dies. This tentative explanation is supported by the fact that the tube-drawing dies, even when successfully used, are less satisfactory than the mandrels. This illustrates the difficulty of obtaining a clean surface and a permanently adherent, uniformly distributed deposit upon the walls of a tubular hole, unless the latter is relatively large. In one plant, a wire-stranding die that has been plated with chromium has yielded over twice the normal service.

In connection with the manufacture of hot-rolled seamless steel tubes, the successful use of chromium-plated drift balls has been reported. This application no doubt rests partly upon the resistance of the chromium to oxidation at the high temperatures employed, as well as upon its resistance to abrasion.

A strikingly successful application of chromium plating on a machine part subjected to wear is found in a 9-inch piston-rod for a Diesel marine engine. It was found that the application of chromium plating, 0.003 inch thick, to the surface of the rod resulted not only in smoother operation and less difficulty with lubrication, but reduced the wear of the rod to a remarkable extent. Unplated rods lost about 0.001 inch in diameter for every 5000 miles of service, while the chromium-plated rods lost no more than this amount in 45,000 miles of operation. These piston-rods ran in a cast-iron packing, with only moderate lubrication.

Very favorable reports have been received regarding the value of chromium plating dies used for forming sheet steel and brass. In some cases, the life of the dies is increased up to eight times the normal service. One special advantage observed with the chromium-plated surface is that the metal does not stick to it as much as to steel. It is significant that the thickness of the chromium coating on these dies is usually less than 0.0005 inch.

Chromium-plated Stamping Dies

In those cases where the metal is formed, or a design produced upon it, by a sudden impact instead of by a steadily applied pressure, the chromium coating is of doubtful value. This is because under such severe conditions the chromium tends to flake or chip, probably because the underlying metal, even when it is casehardened, is at least temporarily deformed. In such cases success is more probable with thin than with thick coatings. A few experiments, not yet completed, upon coinage dies at the U. S. Mint in Philadelphia, illustrate this difference. Dies with a coating of 0.0005 inch or more of chromium all failed in a comparatively short time. Those with only 0.0002 inch of chromium lasted slightly longer than the steel dies, and yielded sharper impressions. While the advantages gained with the chromium-plated dies have not yet warranted their general application at the Mint, they are still under consideration.

In connection with these experiments, it was found that the life of hardened steel collars that hold the coin blanks and fix the diameter of the coins was greatly increased by chromium plating. Thus for the five-cent coins, composed of a nickel-copper alloy, the average service of the chromium-plated collars is about 600,000 pieces, that is, three times that of the unplated collars. Moreover, as the chromium can be stripped at intervals and the collars replated, their life is prolonged indefinitely, and, what is more important, the resultant coins are of more nearly uniform size.

One plant reports favorable results with dies used in hot forging. If this experience is confirmed, the improvement may be due at least as much to the protection furnished by the chromium against oxidation as against abrasion.

Both spinning and burnishing tools may be classified as forming devices, even though the

*Abstract of a paper read before the Machine Shop Practice Division of the American Society of Mechanical Engineers at the annual meeting in New York, December 3 to 7. The first installment of this article appeared in January MACHINERY.

action of the latter is confined to the surface. Several favorable reports have been received upon both of these applications of chromium, though one person found difficulty with flaking of chromium from burnishing tools. It is not clear whether this discrepancy was due to the quality of the plating or to the character of the metal burnished. A few observations at the Bureau of Standards upon spinning tools showed very favorable results from chromium plating.

Successful Application to Molding Dies

One of the most successful applications of chromium is upon dies used for molding plastic materials, such as rubber, bakelite, ceramic clays, etc. The increased service observed is due not only to the resistance of the chromium to abrasion by particles in the molding compound, but also to corrosion by sulphur, phenol, water, or other substances present in the materials. Large chromium-plated metal sheets are being used in presses that produce insulating materials, such as those composed of fiber and phenol condensation products.

Chromium-plated Metal-cutting Tools

The data regarding chromium on tools used for cutting metals are more variable and less favorable than those for any other uses. The general difficulty may be summed up by saying that if the chromium is thick enough at or near the cutting edge to exhibit its great hardness, it is likely to fracture, and if too thin, it soon wears off the edge and offers little advantage. Nevertheless, a sufficient number of successful applications are reported to show that, for some purposes at least, chromium deserves careful consideration. The value of chromium is no doubt affected by such factors as the angle of the cutting edge, the speed of cutting, and the material being cut. In at least a few cases, favorable results have been obtained by plating only one side of the tool with a fairly thick chromium deposit. The tool can then be ground repeatedly upon the steel side, thus always leaving a cutting edge of chromium.

Blanking dies furnish a good illustration of the difficulties encountered with chromium plating, especially when they are used on hard metals such as steel. The impact is such that any fairly thick deposit is likely to flake, and thin deposits usually add but little to the service. On the other hand, such tools as milling cutters, reamers, drills, and taps have frequently shown a material increase in service after plating. Even then, however, the results are likely to be erratic. The most consistent gains are obtained when cutting such substances as slate, asbestos board, and bakelite, which materials cause rapid wear of steel tools.

Saws with Chromium-plated Teeth

The experience with saws of various types is like that with other cutting tools. If a thick coating is applied, there is a marked tendency for the formation of nodules or "trees" upon the points of the teeth. These dull the points, and if, as usually occurs, they break in service they leave the teeth rough and irregular. For such articles, it is therefore preferable to use relatively thin coatings. This conclusion is confirmed by the results reported for hacksaws. Even with thinner coatings of chromium, the hacksaws were not so satisfactory for cutting steel as for materials like slate and asbestos.

In this connection a few experiments are in progress at the Bureau of Standards conducted by J. R. Freeman, Jr., on cutting steel rails with a power saw and high-speed steel saw blades. Some difficulty was encountered in getting a uniform coating of chromium on this alloy, and a very high current density was required. Owing to the tendency to pile up chromium on the teeth, the thickness there was indeterminate, but certainly much greater than the average thickness computed from the current density and time of plating. With an average thickness of about 0.0004 inch, there were very pronounced nodules on the teeth, and it required considerably longer to cut through a rail than with the unplated blade. Even with much thinner coatings, for example, those having an average thickness of about 0.00005 inch, the initial speed of cutting was slightly decreased, showing that there was some dulling of the edges. Some time will probably elapse before conclusive data upon the useful life of the plated saws will be obtained.

One of the most successful applications of chromium plating for wear resistance is on dies used for molding plastic materials, such as rubber, bakelite, and clay products. The increased service is due not only to the resistance of the chromium to abrasion by particles in the molded compound, but also to its resistance to corrosion that may be caused by substances present in the materials being molded. Large chromium-plated metal sheets are used successfully in presses employed to produce insulating materials composed of fiber, bakelite, and similar materials. Favorable results with dies used for hot forging have also been reported.

Chromium-plated Files have Proved Partly Satisfactory

The results reported for files are somewhat similar to those for saws, in that any appreciable thickness of chromium tends to dull the files; but it is reported by several persons that chromium-plated files show much less tendency to clog in use than unplated files. Whenever a material tends to fill the files, the use of light chromium coatings may be justified, even though the useful life of the file may not be greatly increased. In some cases, however, an increase to double the original service was obtained.

A few reports upon woodworking tools, including saws, chisels, and lathe tools, show that their life is very greatly increased by the use of chromium coatings. Results with rock drills are still uncertain. Experiments are also being made by one firm on chromium-plated plowshares. For this purpose, the resistance to corrosion may be helpful, even if the actual cutting edge is not greatly improved.

Chromium-plating Machine Parts to Resist Wear

In spite of the apparently obvious applicability of chromium upon all parts of machinery that are subject to wear in service, such use is still far from being a general or even a preferred practice. The failure to adopt chromium for such purposes may

be due to various causes, including the size or inaccessibility of many of the parts, and the fear that if the chromium should become detached from a bearing surface, the particles would serve as an abrasive and cause permanent injury to the mechanism. While the latter possibility warrants careful consideration and proper caution, the probability of its occurrence is not evident from the meager data available.

In a few cases, chromium-plated gears have proved satisfactory. Such uses are, however, most promising on light equipment such as speedometers, counting machines, etc. For such purposes, they have reduced the noise of operation and also increased the useful life.

One strikingly successful application of chromium plating has been on 9-inch piston-rods of Diesel marine engines. These rods run in a cast-iron packing with only moderate lubrication. It was found that the application of 0.003 inch of chromium to the surface of the rods resulted in smoother operation and less difficulty in lubrication. The unplated rods lost about 0.001 inch in diameter for every 5000 miles of service, while the chromium-plated rods required 45,000 miles of operation to produce the same loss in diameter. Incidentally, these piston-rods, which were water-cooled, were also plated on the inside with chromium, which greatly reduced the corrosion.

Chromium-plating in the Printing Industry

Although printing plates are not ordinarily considered part of a machine, they virtually become part of a printing press when in use. The experience with printing plates may therefore be suggestive. Currency plates consisting of electrolytic nickel, coated with chromium, yield about twice the number of impressions obtainable from casehardened steel plates. Curved stamp plates, made of casehardened steel and chromium plated, yield about double service, and can be stripped and replated several times before being worn out. Nickel electrotypes, when chromium plated, produce from 3 to 5 times the normal number of impressions, and are therefore extensively used for large editions, such as wrappers, labels, and cartons. It should be noted, however, that in all these applications, the chromium is valuable for its resistance to abrasion, and does not materially add to resistance to deformation or fracture if for any reason the plate is subjected to excessive strain or sudden shock.

Summary of Results Obtained by Chromium Plating

Chromium plating owes its application upon mechanical equipment primarily to its great hardness, as exhibited in its resistance to abrasion. The chief limitation in the use of chromium for such purposes is its extreme brittleness, which may cause it to crack and flake when deformed. The most successful mechanical uses of chromium are on measuring instruments, such as gages of all types, the service of which is often multiplied several fold. On forming and molding dies, it is generally satisfactory and beneficial, especially if the conditions do not involve too severe impacts. On cutting tools it is of doubtful value, though in numerous applications it has proved successful. On moving parts of machinery there have been but few successful applications, but these indicate that with further study many such uses may be developed.

It is impossible to estimate even roughly the savings that have been or may be accomplished through the use of chromium on mechanical equipment. The cost of the tools or devices that may be dispensed with because of the greater life of those that are chromium plated represents only a small part of the economic gain. The money saved in reducing the number of times that a machine must be stopped for replacement of a tool or die may amount to many times the cost of the device. Perhaps the greatest gain is the somewhat intangible but far-reaching benefit arising from the manufacture of more uniformly dimensioned parts.

Chromium plating is not a panacea for wear. An everlasting tool or machine is as visionary as perpetual motion. Chromium plating has, however, solved many machine shop problems, reduced costs of operation, and improved the quality of the products. When we recall that almost all this progress has been made in less than three years, there is good reason to believe that with the large number of investigators now at work on this subject, even greater results may be expected.

* * *

USE OF ALUMINUM IN AUTOMOBILES

"In passenger cars, a definite trend toward increased use of aluminum seems to be under way," writes R. S. Archer in the *S. A. E. Journal*. "The present emphasis in manufacturing automobiles seems to be on performance, although cost is also watched very closely. It is perhaps as a result of the present insistence of the public on performance that more aluminum is being used, as, for example, in the increased use of aluminum pistons. An experimental aluminum car has demonstrated very clearly that aluminum construction offers unusual possibilities in the way of performance.

"In the operation of commercial vehicles, such as motor coaches, taxicabs, and motor trucks, it seems that very real and important economies can be achieved by the extensive use of aluminum. In the case of the heavier vehicles there is also the consideration of the legal restrictions on maximum load on certain highways. These restrictions indicate that it is cheaper for the general public to have lighter vehicles than to keep rebuilding roads to withstand heavy vehicles."

* * *

According to figures published by the Aeronautical Chamber of Commerce, over 4000 planes were built in 1928. The prospects are that 12,000 planes will be manufactured in 1929. Less than 2000 planes were built in 1927. Airplane manufacture centers in three cities—Detroit, Mich.; New York; and Wichita, Kan. In the latter city, it is expected that 2000 planes will be produced next year. The metropolitan district surrounding New York, however, leads in production, and at least 3000 planes are planned for in 1929 in this section. It is believed that the total value of airplane products in 1929 will reach $100,000,000.

Methods Used in Molding Bakelite Parts

Presses for Bakelite Molding—Molds Employed—Methods of Ejecting Parts from Molds—Accuracy of Molded Parts

By R. A. LOWE

BAKELITE is a synthetic resin made of carbolic acid and formaldehyde. In producing bakelite molding materials, wood flour is added to this resin to give mechanical strength and asbestos for the purpose of resisting heat. When the material reaches the molder, it is in the form of a powder. For clarity, the term "bakelite" is used throughout this article, but the conditions in general apply to all molding materials that have synthetic resin as a base and that depend upon the chemical reaction between carbolic acid and formaldehyde to produce the molded part, regardless of the kind of filling or coloring matter used.

The molding material, when placed in a mold and subjected to the proper heat and pressure, becomes hard and cannot be softened by further heat, owing to the chemical change which takes place. Bakelite, in this state, is a hard, light substance which is chemically inert, mechanically strong, and a good insulator. At present, many firms specialize in molding articles to suit their customers' requirements and, in addition, design and construct molds, but with the growing use of molded parts in all industries, it becomes necessary for designers generally to become acquainted with the design of bakelite molds, to avoid the redesigning of parts so they can be molded economically.

Fig. 1. Examples of Molded Bakelite Parts

Molding Versus Machining

The bakelite molding process can be applied with advantage to complex parts, which, if built up from several units machined from different materials, would require a large number of turning, milling, drilling, tapping, inspecting, and assembling operations. The main points to consider in deciding whether or not a certain part should be molded in bakelite are as follows:

1. Cost of mold and cost of required number of pieces molded.
2. Cost of required number of parts produced by alternative methods and in various materials.
3. Output required.
4. Comparative appearance.
5. Comparative durability and accuracy.

Brief Review of the Molding Process

The molding process consists of placing a measured quantity of the material in the mold and subjecting it to a temperature of 300 to 350 degrees F. and a pressure increasing from 500 to 2000 pounds per square inch of the projected mold area. This causes the powder to become plastic, and at the same time the volume decreases. The heating continues until the material becomes hard and solid. When this has taken place, the volume of the part is equivalent to about one-half the original volume of the powder. These conditions of heat and pressure are maintained for a period of from one to seven minutes, varying with the size of the molding.

The molded part may be immediately removed from the mold, of whose negative contour it is a faithful positive replica. Even the smallest scratches and file marks are reproduced accurately on the molded part. This is one reason why the bakelite molding process is an ideal method of producing large numbers of similar parts such as knobs, dials, switch and magneto parts, battery boxes, ash trays, combs, and similar products. Examples of molded parts are shown in Fig. 1. An accuracy of $\pm$ 0.005 inch can be easily attained, and with special care an accuracy of $\pm$ 0.002 inch is possible.

Obtaining the Required Pressure

Hydraulic presses are used in most cases for bakelite molding, because as the material fluxes under the influence of heat its volume becomes less, and it is necessary to follow up this change of volume with a constant pressure. For this purpose, a power-operated hydraulic press is ideal. The heat for the hot plates of the press and the mold is furnished by steam which, due to its latent heat, enables the temperature to be easily controlled or maintained at a constant value.

Methods of Heating Molds

In order to heat and maintain the mold at the required temperature of from 300 to 350 degrees

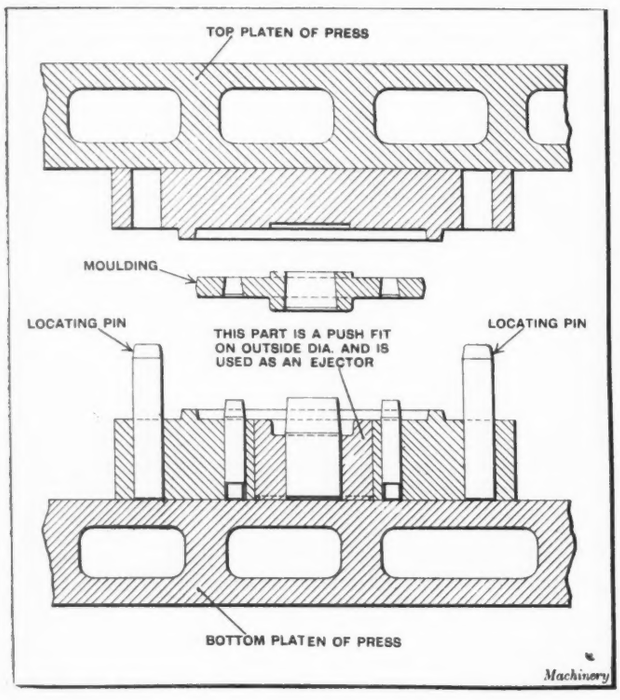

TOP PLATEN OF PRESS
MOULDING
LOCATING PIN
THIS PART IS A PUSH FIT ON OUTSIDE DIA. AND IS USED AS AN EJECTOR
LOCATING PIN
BOTTOM PLATEN OF PRESS
Machinery

Fig. 2. Flash Mold for Producing One Part at a Time

F., the steam plant should be capable of maintaining a pressure of 150 pounds per square inch. When only a small capital outlay for equipment is available, electric heating of the platens may be substituted for steam, and the cost of boilers and the floor space required for steam-heating saved. When electric power is not available, gas may be used, but this is not recommended when either of the other methods can be employed.

Types of Molds Employed

The three main types of molds used are: (1) Flash molds; (2) positive molds; and (3) positive flash molds. In Fig. 2 is shown a flash mold in its simplest form. This mold consists of two parts, a top plate and a bottom plate, which may be fixed to the top and bottom platens of the press, respectively, or may rest on the bottom platen, both parts being removed to eject the molded part and recharge the mold. The bakelite is usually put in this type of mold in the form of a tablet. These tablets are made in machines which may be automatically operated and eliminate the necessity for weighing each separate charge of bakelite powder.

After the tablet is placed on the bottom part of the mold, pressure is brought to bear upon it through the medium of the top part or "force." A slightly greater amount of bakelite than is actually required to fill the mold must be used for the following reason: The bakelite is not totally enclosed within the mold until the two plates actually come together, and, therefore, a thin flash is formed between the two plates. This flash is very thin and may be removed quickly and easily from the molded parts by a flashing die or by buffing the edges.

Making Flash Type Molds

The flash molds are usually in multiple form and consist of a number of units mounted in a common plate or holder, as shown in Fig. 3. This facilitates the removal and repair of any single mold unit which may become damaged or worn. In producing the mold units, it is often possible to use the hobbing or embossing process. A hardened steel master is made to the exact contour of the required part, as shown at *A*, Fig. 5, which in this case is a dial having graduations sunk below the surface. This master die is then pressed into a soft steel unit which has been machined to the required shape as close as is practicable. This produces an impression of the article which is to be molded.

It is generally necessary to anneal the mold several times before the full impression can be drawn up, in order to prevent the metal from cracking. Thus the hobbing fixture must be provided with a suitable device for locating the mold in the correct relation to the master as the impressions or "strikings" are repeated.

When the mold has been satisfactorily impressed, it is machined on the outside to fit the adapter plate, and the inside or molding face is burnished. The mold is then casehardened, care being taken to see that no blistering takes place, as all marks will be reproduced in every molding, and should the marks be inaccessible to machine lapping, their removal is a tedious operation.

Positive Type Molds

The positive mold consists of a minimum number of three parts: (1) The outer wall or bolster; (2) the top force; and (3) the bottom force. All these parts may assist in forming the contour of the part according to the arrangement best suited to the shape to be molded. In Fig. 4 is shown a positive mold for producing the bowl shown at *A*. Positive molds are most often designed for the use of molding powder. Consequently, the bolster must be made of such height that the powder is totally enclosed within the mold before pressure is applied. Also, the top force must be of such length that when its top face is a few thousandths of an inch above the top face of the bolster, the part being molded is reduced to its correct dimensions.

For this reason, the amount of powder charged in the mold must be weighed accurately. The amount required is first decided by trial when making the experimental "pulls" or parts with a new mold, and the strictness with which this

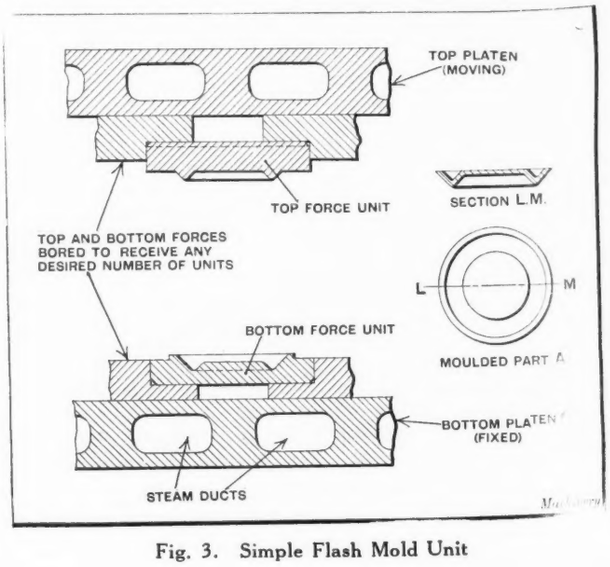


Fig. 3. Simple Flash Mold Unit

amount is adhered to depends upon the limits of accuracy demanded. If too much powder is inserted in this type of mold, the molded part will be oversize on the dimensions governed by the distance the top force enters the mold.

If too little powder is placed in the positive mold, the part will be defective in appearance, the more remote surfaces being pitted and having a porous appearance. Also, the molding will be brittle and more likely to warp on cooling. In practice, however, little difficulty is experienced in this respect, as any small error made in the volume of the powder charged into the mold is reduced by one-half, owing to the reduction in volume which takes place. Often the mold can be designed in such a manner that the important dimensions are not affected by the accuracy of the powder charge.

Combining the Features of the Positive and Flash Type Molds

Positive molds are more expensive than flash molds, and for this reason they are used only when it is impractical to use the latter type. A third type of mold, known as the "positive flash," is, as the name indicates, a combination of the two types previously described. It takes the form of a flash mold, the bottom plate of which is provided with a surrounding wall or bolster so that the mold may be charged with one filling of powder instead of with separate tablets. The impressions are hobbed or machined, as may be necessary, in the bottom force and partly in the top force, as required, according to the form of the part to be produced. The top force is arranged so that it enters the bolster and subjects the powder to pressure in the same manner as with the positive mold.

The quantity of powder placed in the mold is so adjusted that the amount of flash is kept at a minimum. Parts produced in a mold of this kind are joined by the flash, which may be removed in the manner previously described.

Methods of Ejecting Parts from Molds

Forcible ejection of the parts from positive molds, when necessary, is most commonly accomplished in the following manner: (1) By ejecting both forces from the bolster. (2) By the provision of ejector pins on the under side of the bottom force (used when method (1) is insufficient).

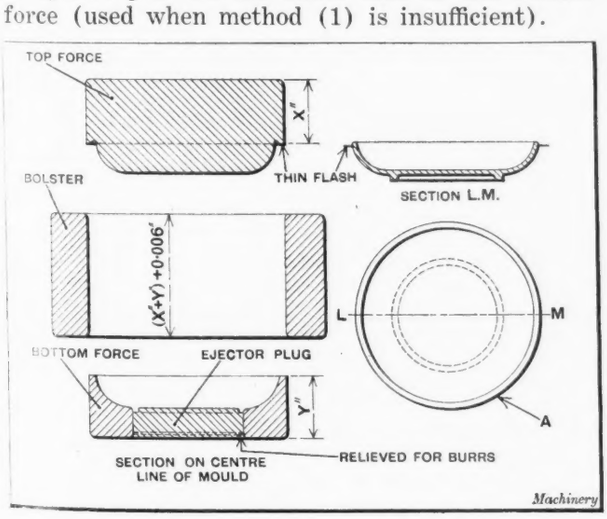


Fig. 4. Positive Mold for Producing Part A

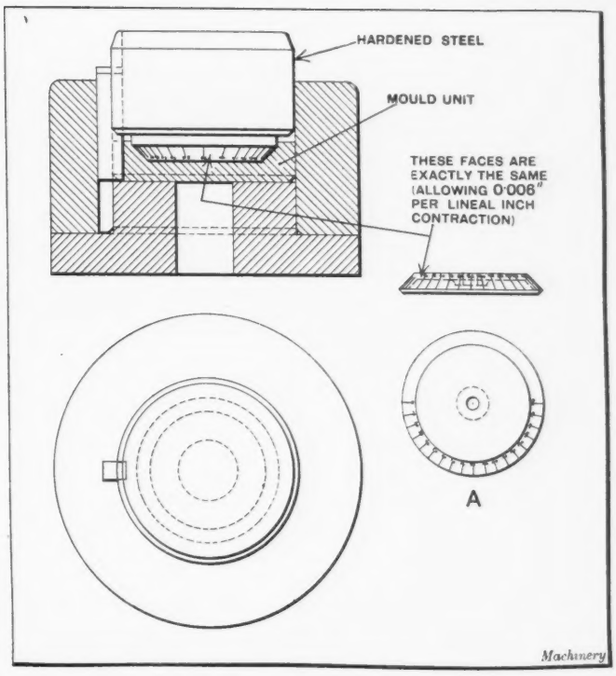


Fig. 5. Mold Unit Hobbing or Impression Tool

In the case of flash molds, ejection is accomplished as follows: (1) Where the mold is arranged so that the part is drawn from the bottom plate by the top plate, it is ejected from the top plate by means of ejector pins operated by the press as it makes its return stroke.

When this is impracticable, the following method is used: (2) By making some part of the bottom of the mold removable in the direction opposite to that in which the pressure acts, and by forcing out the molding with this removable part. This may also be done in a positive mold, such as shown in Fig. 4. On small molds, a rawhide mallet may be used to knock out the moldings, but should either the delicacy or the size of the moldings call for other means, an arbor press can be used.

From the foregoing, it is obvious that molding methods naturally fall into two subdivisions. In one division, the method is semi-automatic where a multiple mold is fixed in a press that is (1) equipped with steam-heated cored platens and, where necessary, water-cooling; (2) arranged for use with tablets supplied from a tableting machine; or (3) fitted to give automatic ejection of parts, a method that is used for mass production.

In the second subdivision, we have the single mold, which is not secured to the press. In this type, we have an arrangement whereby larger and more complicated parts can be handled. This method is not so rapid, but requires less capital for equipment. An operator usually operates two presses equipped in this manner. When one mold has been charged and the pressure and heat have been applied, the molding is left to harden while the other press is lifted, and the molds ejected, cleaned, and recharged. The operator then returns to the first press and repeats the operation when the part has completely hardened.

When the mold is once hot and has been recharged, it must be subjected to pressure as soon as possible, because the chemical reaction in the

powder commences with the application of heat. Therefore, if the material should harden before the mold has been closed, a faulty part will be produced.

Designing Molds to Suit Production Requirements

Although it is possible to take several impressions from a mold made of soft steel or brass, the number of pieces that can be produced in a soft mold of this kind depends to a great extent upon the design of the mold. Soft molds are, as a rule, only used for experimental purposes, but it is sometimes possible to make as many as 2000 impressions from one that is correctly designed. Usually, however, it will be found advisable to make molds of hardened steel.

The best steels for the purpose are nickel-chrome and cobalt-chrome steel, but freedom from distortion is a criterion that must be adhered to. When hardened and polished, molds made of such steel will give from 80,000 to 120,000 impressions. The molding powder itself has no effect upon the metals chemically, so that there is no staining of the molds. The life of a mold is usually limited only by the wearing of the parts that slide in contact. Actually, steel is not in contact with steel, as the material creeps up the joints and has an extremely abrasive effect on the mold. This is really the factor that determines the life of the mold.

Mechanical and Electrical Properties of Bakelite

Test	Bakelite Molded (Wood Flour)	Bakelite Molded (Asbestos Fiber)
Tensile strength	4500 to 6000 pounds per square inch	4500 to 6000 pounds per square inch
Compressive strength	25,000 to 36,000 pounds per square inch	18,000 to 36,000 pounds per square inch
Transverse strength	10,000 to 15,000 pounds per square inch	15,000 to 30,000 pounds per square inch
Hardness (metal scale)	70 to 110 Shore soft	—
Coefficient of expansion	0.00003 inch per deg. C.	0.00002 inch per deg. C.
Specific gravity	1.35	1.85
Weight per cubic inch	0.78 ounce	1.08 ounces
Dielectric strength	250 to 700 volts per mil.	150 to 500 volts per mil.
Dielectric constant	4.5 to 7.5	4.5 to 7.0
Volume resistivity	3×10^{10} ohms per cm^3 at 20 deg. C.	—
Power factor	1 per cent to 6 per cent at 10^6 cycles per second	—

Machinery

Limits of Accuracy Possible

When greater accuracy than 0.002 inch is essential, an allowance should be made for machining. Holes smaller than 5/32 inch in diameter are difficult to mold, if their depth is greater than twice their diameter. They may be obtained by molding-in drilled metal pieces called "inserts," but these must be adequately supported to withstand the flow of the plastic material. Holes may be readily drilled in bakelite but usually come up under-size. Over-size drills are the remedy. Because a molding contracts 0.006 inch per inch on cooling, after being removed from the mold, metal inserts should be placed a reasonable distance from the edge of the molding to avoid cracking due to unequal contraction.

Large metal inserts should not be molded-in, except where it is possible to design the surrounding molding in such a manner as to allow flexure, which will, in turn, relieve the stresses induced by unequal contraction. All inserts should be supported and held positively, so that the molding pressure will tend to force them into their proper locations, because molten bakelite will find its way into any small spaces produced by a change of position in the molds.

For quick ejection of moldings, a draft of 3 degrees face or 6 degrees included angle is preferable, but holes may be molded with a draft of 0.004 inch taper or reduction in the diameter per inch of length, when particularly desirable, as in the case of thin-walled bosses.

Molding Threaded Parts

Very fine threads should not be molded. Mandrels for forming threads should always be shouldered, so that a threaded hole will have a slight counterbore. This construction facilitates the withdrawal of the former, gives a cleaner appearance to the moldings, and assists in the subsequent assembly of the finished molding by leading the threaded part into the hole.

Inserts that have externally threaded parts projecting from the molding should be undercut at the base of the thread so that a close joint is made between the insert and the portion of the mold in which it is held. Otherwise, the plastic bakelite may find its way into the thread, and render the withdrawal of the mandrel difficult by forming a wedge in the small space which may be caused by the tolerance of the thread. Alternatively, the internal thread in the mold may be counterbored. This has the advantage of eliminating the operation of undercutting each externally threaded part, should it be unnecessary or undesirable for other reasons relating to the finished article.

Avoid Under-cuts and Projections When Possible

Under-cuts or projections on a mold or part that are not parallel to the direction in which the part is ejected are to be avoided where possible, because they necessitate side pieces in the mold. This not only increases the cost of the mold, but the removal of the side pieces is an operation that must be performed prior to the ejection of the molded part. It is to be emphasized that the foregoing does not imply that such features in a molding are necessarily bad design. Under-cuts or projections for which the need is imperative should most emphatically be molded in position, in preference to adding them subsequently by machining methods.

Recessing and Coring Cut Costs

Moldings may be deliberately recessed or cored out in the direction of draft to advantage, because this reduces not only the amount of material used in each part, but the curing time, thus giving a double saving in the cost of each molding. Such

coring of moldings is limited by the mechanical strength necessary, and by the access of sufficient pressure to the plastic material in the recess. In general, the proportions allowable are such that a recess 1 inch deep should not be narrower than 1/8 inch. Great care should be taken when lightening a mold in this manner to see that the flow to other parts of the mold is not restricted.

Flow of Bakelite Must Be Considered In Designing Mold

In designing any mold, it should always be remembered that when the bakelite is plastic and under pressure, the conditions within the mold are not hydrostatic, as is usually supposed. To understand this more clearly, it must be recalled that, as stated previously, a completed molding is approximately only one-half the volume of the powder originally charged into the mold, and as this reduction is taking effect up to the last stage of molding, it will be clear that the material, gradually becoming more dense, has to flow to remote parts of the mold, such as ribs, deep bosses, etc.

For this reason, the material in its last stages of reduction of volume tends to carry any former, projection, or insert in the direction of its flow. This flow is most pronounced at entrances to cavities in the mold, and any inserts, projections, or formers should be arranged so as to resist or avoid its effects, but care must be taken to see that the flow is not seriously impeded.

Avoiding Trapped Air Difficulties

In a mold that has deep recesses, trouble may be experienced from air being trapped within them. This may be remedied by loading the recess with bakelite powder and forcing it to the bottom with a small piece of brass rod of suitable form, in order to displace the air. Where a tableting machine is available, the bakelite powder may be preformed into a tablet that will fit closely into the recess.

Strength and Electrical Properties of Bakelite

The accompanying table gives the results of laboratory tests on bakelite, and may be relied upon in designing any part that has to withstand stresses in service which can be computed. These stresses, however, cannot be accurately estimated for the majority of molded parts. In order to obtain a mental impression of the strength and elasticity of molded bakelite, it is recommended that a specimen of the material be broken, sawed, and filed, and that specimens of ebonite, hardwood, brass, or steel of approximately the same proportions be treated in the same manner. Thus by working the material with the hands, it will be possible to acquire a mental judgment of it as easily as one is able to decide whether to use brass or steel, or mild steel or nickel steel for a certain part without resorting to figures.

Building 4000-H.P. Diesel Engines

The leading article in March MACHINERY will deal with the building of the largest Diesel engines ever constructed in this country. These engines are built by the Hooven, Owens, Rentschler Co., for driving 10,000-ton vessels operated by the United States Shipping Board. The crankshaft of these engines weighs 77,000 pounds, and the connecting-rods measure about 10 feet between centers and weigh 8000 pounds. Everything else is in the same proportion. The article will prove of great interest to mechanical men familiar only with the manufacture of small and medium-sized machinery.

FIRST ARC-WELDED OFFICE BUILDING

The first commercial store and office building to be erected by the arc-welding process has just been completed in Cleveland, Ohio. The building, known as the Upper Carnegie Building, was designed and built by the Austin Co., and the welding was done by the Lincoln Electric Co. The building is four stories high, 60 feet wide by 119 feet long. It was designed especially for arc-welding and, therefore, contains many new and unique features of construction. One of the features of the building is the use of continuous horizontal beams, with columns extending from floor to floor. This construction permitted a reduction in the size of the beams and enabled the columns on each floor to be made proportional to the load carried.

The complete story of the application of the electric arc to the erection of the building is portrayed in a motion picture produced by the Lincoln Electric Co. The picture shows the fabricating of the steel in the fabricating shop, and depicts the progress of the work up to the completion of the building. The picture consists of three reels and can be conveniently shown in an office, club, or classroom. It may be obtained without charge for exhibition purposes upon application to the Lincoln Electric Co., Cleveland, Ohio.

* * *

FOUNDRYMEN'S CONVENTION AND EXHIBIT

The annual convention and exhibit of the American Foundrymen's Association will be held at the Stevens Hotel, Chicago, Ill., April 8 to 11. Numerous technical sessions will be held on the third floor of the hotel, while the exhibits will be located on the basement level, one flight below the main lobby, where 31,000 square feet of exhibition space is provided. Among the subjects that will be given particular attention during the convention are foreman training, apprentice training, non-ferrous foundry costs, and sand control.

The apprentice contest inaugurated at the 1924 convention, with only Milwaukee firms participating, has grown in interest until the contest for 1929 will be held in three divisions—gray iron molding, steel molding, and patternmaking—with three prizes of $50, $25, and $10, respectively, in each division. Local contests to determine the castings and patterns to be entered in the national contest can be held either by individual plants, local foundrymen's associations, or similar organizations, in accordance with the rules and regulations laid down by the Apprentice Contest Committee of the association. The entries for the national contest must reach Chicago not later than April 2.

Copies of the regulations and shipping information may be had upon application to the secretary of the association, 222 W. Adams St., Chicago, Ill.

Making Irregular-shaped Flanged Cylinders

Tools Used for Producing Long Oval-shaped Cylinders in Quantities of About Two Thousand per Day

By LUCIEN L. HAAS

THE equipment described in this article was developed for use in the production of long oval-shaped cylinders from 22-gage sheet steel. These cylinders, one of which is shown in the lower right-hand corner of Fig. 1, are required to be produced in large quantities. An inner member, not shown in the illustration, is inserted at the point where the two sections are joined by electric welding. To facilitate production, the cylinder is made in one piece and then cut apart to permit the inner or baffle member to be inserted. In order to join the ends of the two pieces properly, it is necessary that they be flanged, as shown in the view at the extreme right in Fig. 2.

As from 2000 to 2200 pieces were to be made per day, it was necessary to provide an efficient means for forming the flanges. After considering various methods, it was decided that the work should be done on a punch press. The die designed for forming the flange is shown in Fig. 1. The first operation in producing the cylinders is to cut the blanks to size and form them into cylinders having lock seams. This was accomplished by conventional methods which need not be described here. Next, the cylinders were cut apart, as previously mentioned, and brought to the punch press to be flanged in the die shown in Fig. 1.

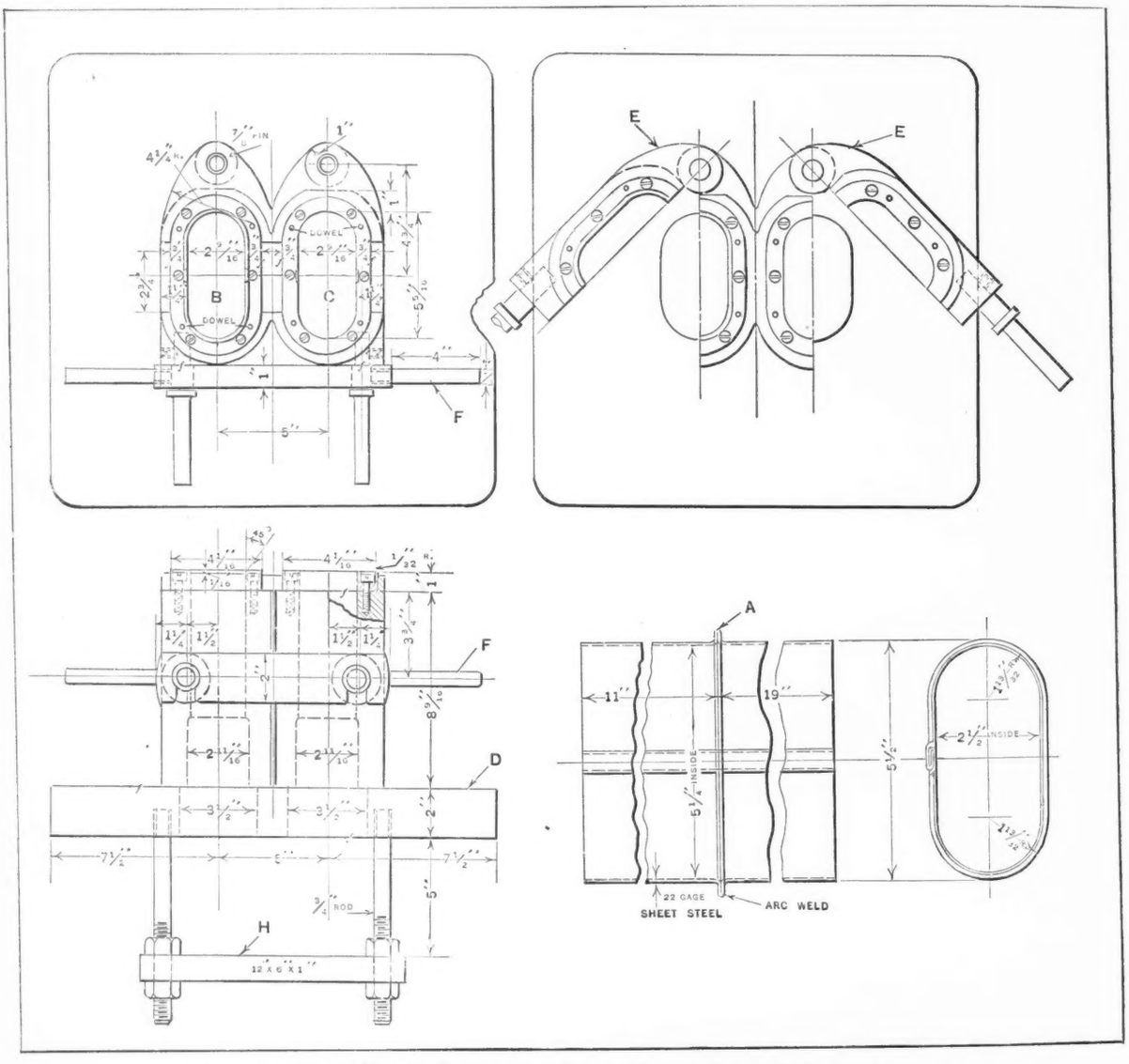


Fig. 1. Flanging Die for Sheet-steel Cylinder Shown in Lower Right-hand Corner

It will be noted that the flanging die is of the double type, and that the two sections of the die are cut through the centers and the two outside

halves *E* hinged to the stationary members. The members *E* can therefore be swung to one side to permit the work to be placed in position for flanging. After placing a piece of work in the die at the left, the two members *E* are closed and locked in place by the slotted bar *F*. When the ram of the press descends, the punch member *K*, Fig. 4, forms the flange to an angle of 45 degrees, as shown in the first-operation view, Fig. 2. The locking bar *F*, Fig. 1, is then removed, the half members *E* swung back, the flanged piece transferred to the die at the right, and a new piece placed in the die member at the left.

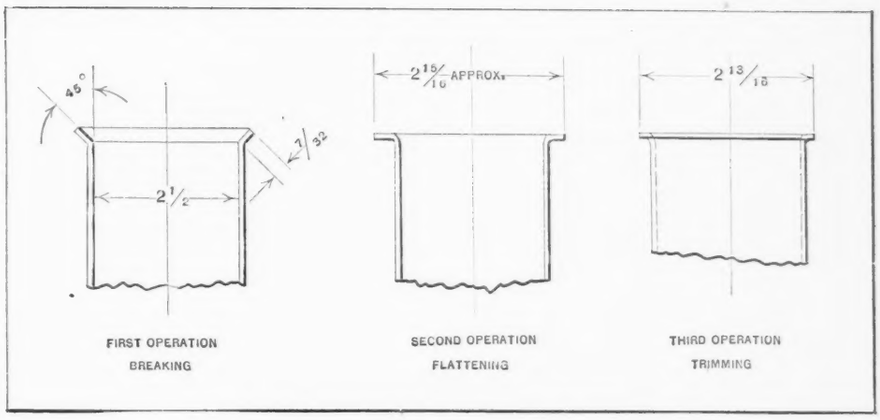


Fig. 2. Successive Steps in Forming Flanges

On the next stroke of the press, the punch *L*, Fig. 4, completes the flanging operation on the part previously flanged to an angle of 45 degrees. The completed flange is shown in the second-operation view, Fig. 2. The die is then opened, and the completely flanged part is removed and replaced by the piece in the left-hand side of the die which was flanged to an angle of 45 degrees in the same operation. A new piece is then placed in the left-hand side of the die and the operation repeated. By operating the double die in this manner, a completely flanged piece is produced at each stroke of the press. The swinging members *E* serve to bring any cylinders that may have been deformed by handling, back to the proper oval shape.

The adjustable plate *H*, Fig. 1, serves as a stop or rest for the cylinders when they are placed in the die. The various details of the die are shown quite clearly in the illustration and require no further explanation. The punch shown in Fig. 4 is provided with pilots *M* and *N*, which enter the cylinders to a depth of about 1 inch before the actual breaking and flattening of the flanges takes place. It was found necessary to provide pilots on the punch in order to eliminate trouble from slightly distorted cylinders, which otherwise could not be properly flanged. The use of the pilots also made it unnecessary to provide guide or pilot posts for the punch member.

The edges of the flanges formed in the die were naturally somewhat irregular in shape, and were therefore subjected to a trimming operation, so that they would match properly when assembled for welding. The die used for trimming the flanges as indicated in the third-operation view, Fig. 2, is shown in Fig. 3. The die member *D* is mounted on the slide *F*, which is withdrawn from under the trimming punch *G* to permit the work to be placed in position. This is necessary, as the maximum height of the punch above the die is not sufficient to permit the work to be inserted directly in place. After the cylinder to be trimmed is in place, the slide is carried forward in position under the punch, where it is located by the spring-actuated stop *S*.

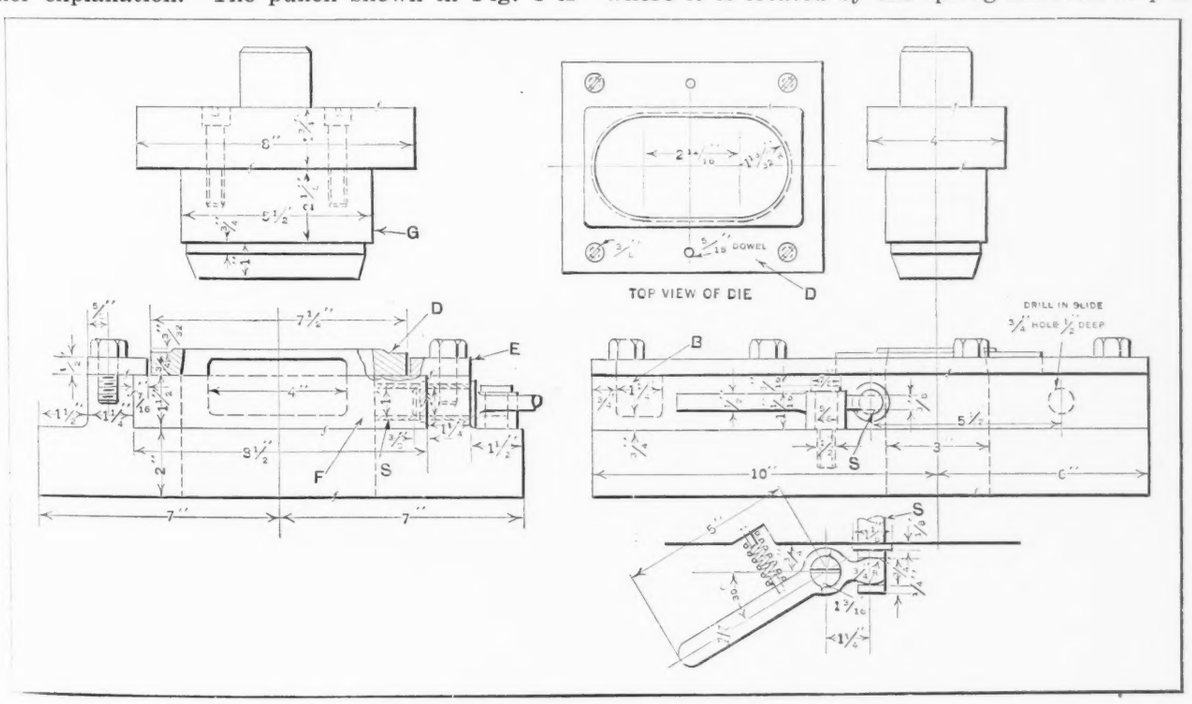


Fig. 3. Die for Trimming Flanges of Cylinders

A cored finger-slot at *B* facilitates the withdrawal of the sliding member.

In Fig. 5 is shown a special holder employed to align the two sections of the cylinder when performing the welding operation which joins the two flanges together, as indicated at *A*, Fig. 1. When the lever *A*, Fig. 5, is pushed to the left, the spindle *E* is carried to the left, so that the work can be placed over the adapters *B* and *C*. After the two pieces are in place on the adapters, the lever *A* is moved to the right with sufficient pressure to hold the flanged ends securely in contact, and the locking lever *D* is tightened. The work, with the flanges properly matched, is then rotated by hand while welding the flanges together with an electric arc. When this equipment was first constructed, a worm and worm-wheel drive was provided for rotating the spindle by power, but it was found that the work could be handled more easily and satisfactorily when the spindle was rotated by hand.

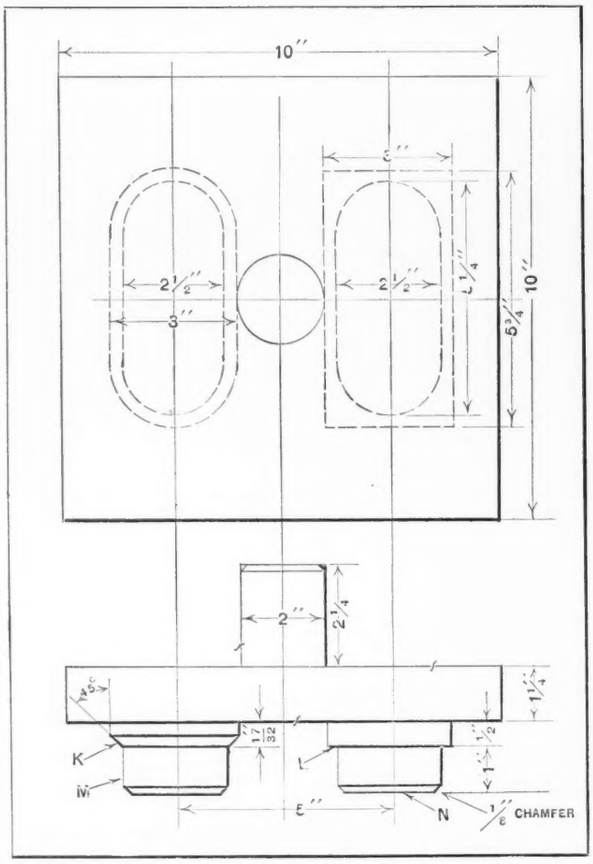


Fig. 4. Punch Used with Die Shown in Fig. 1

DEVICE FOR MOVING RAILROAD CARS

The "spotting" or placing of freight cars at a certain point for loading or unloading raw materials or finished equipment is a problem of interest to every large industrial plant having railway sidings. For this purpose, the Foote Bros. Gear & Machine Co., Chicago, Ill., has developed a so-called "car-spotter," which is an electric motor-driven unit consisting of a motor, a vertical worm reducer, and a capstan, compactly mounted on a cast-iron base. With this device, one operator can place a string of cars in position in a fraction of the time that it would take several men to move the cars by hand-operated car-movers. The device is made in two sizes, one having a 3000-pound rope pull and the other a 6000-pound pull. The capacity of these car pullers depends also upon the degree of curvature and the grade of the track. These two factors must be taken into consideration in selecting the size of unit required.

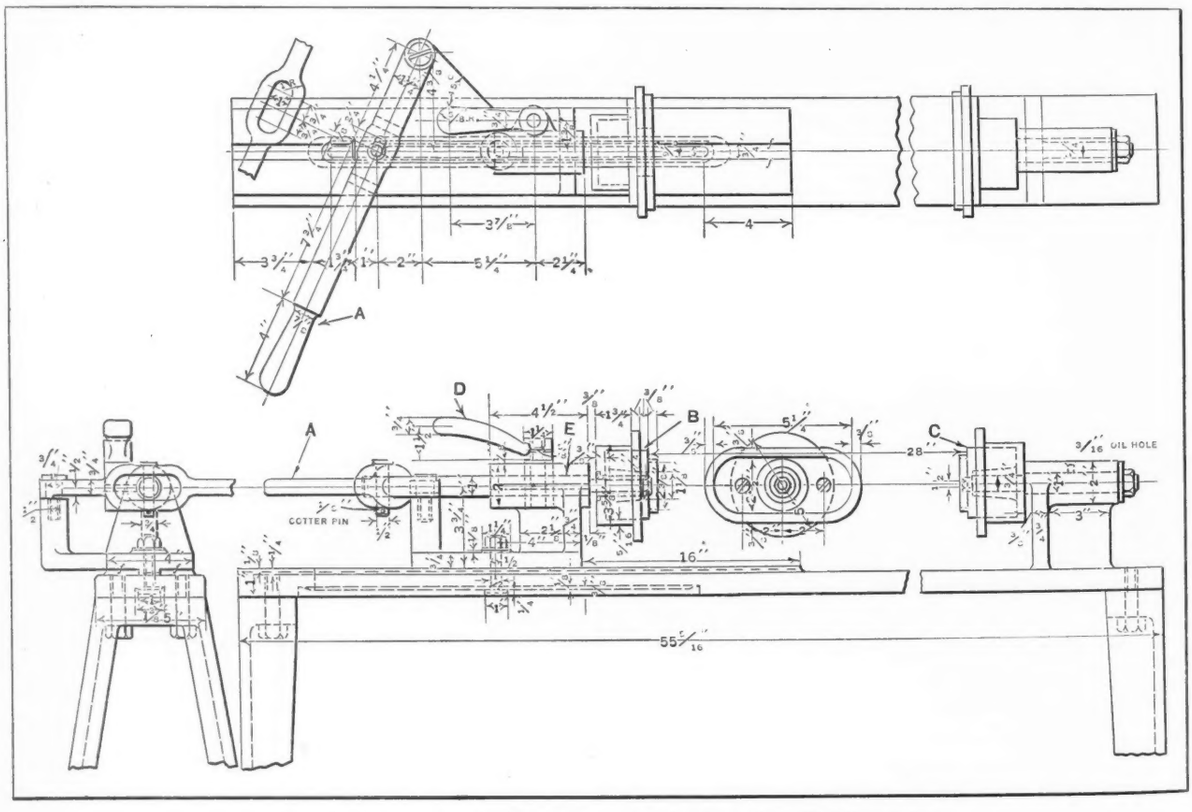
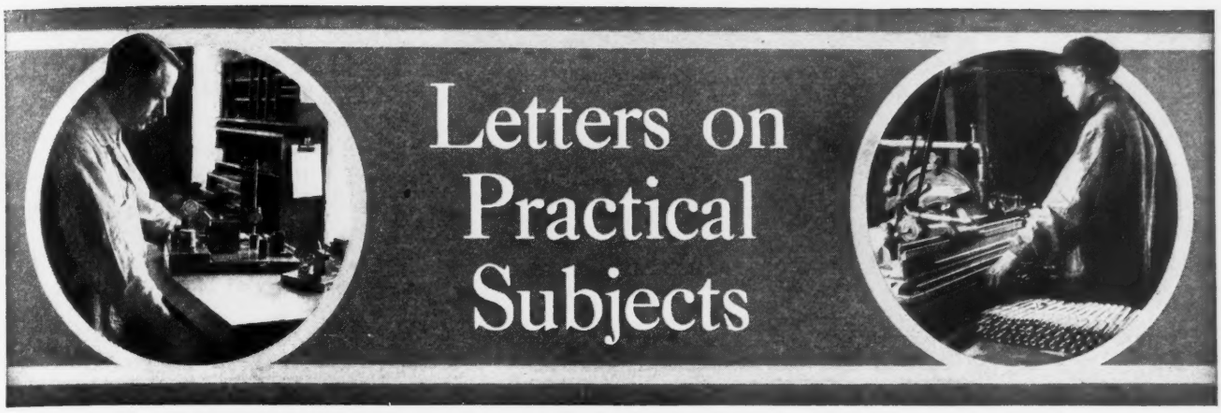


Fig. 5. Fixture for Holding Flanged Cylinders while Welding Joint



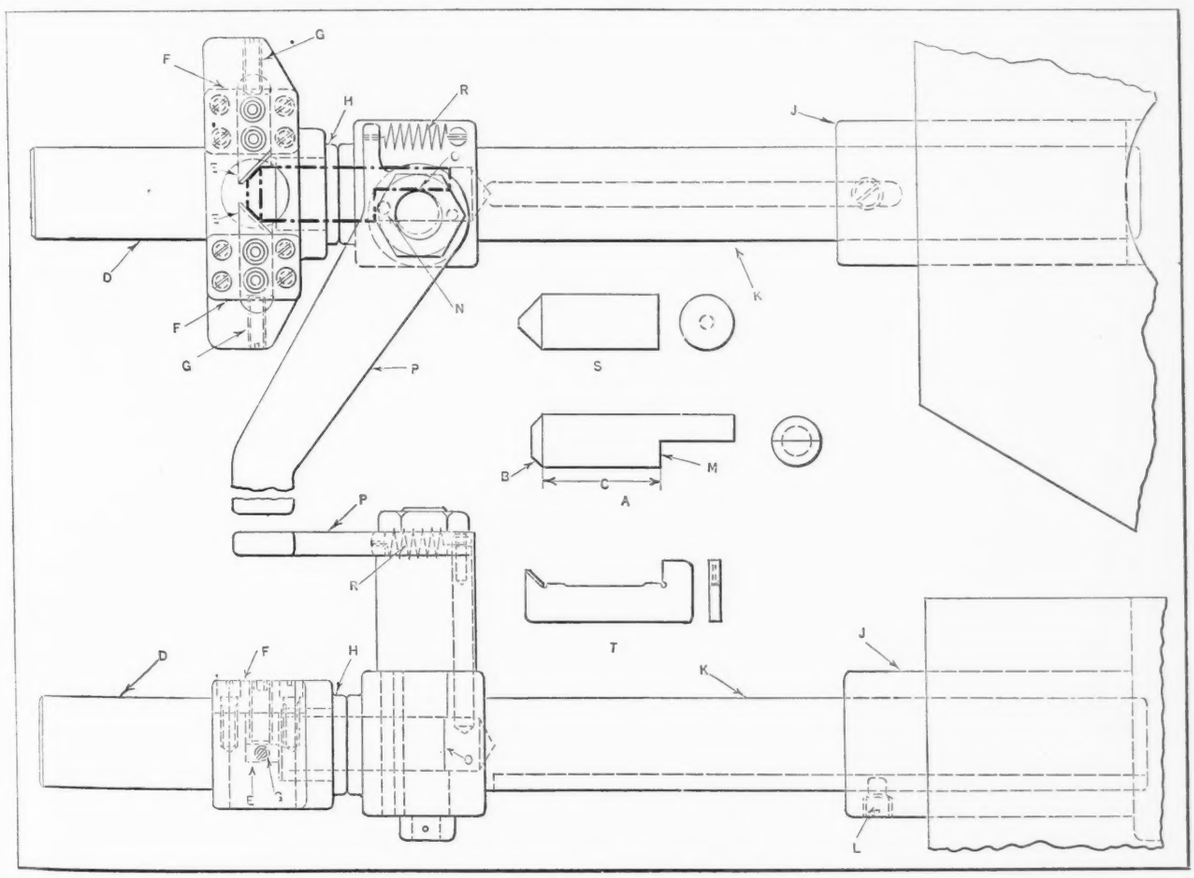
QUICK-ACTING TOOL FOR TURRET LATHE

The brass valves shown at *A* in the accompanying illustration were required to be machined very accurately in order to seat properly when assembled in the finished product. The bevel *B* and the dimension *C* which were the most important parts, were machined to the required accuracy by the tool illustrated. The bevel is rough-turned previous to this operation.

The beveling tool *D* has two cutting blades *E*. This tool is held in a draw-in chuck in the spindle of a turret lathe. The blades are a snug sliding fit in the slots in the holder, and are held down by headless set-screws threaded through the cover plates *F*. Adjustment of the cutting blades is effected by means of the screws *G*, which also restrain the blades against radial movement. A hardened bushing *H* is pressed into the front end of the holder to guide the work accurately toward the blades. The central hole, at right angles to the cutter blades, is for chip clearance.

In one station of the turret is placed a bushing *J* in which slides the work-holder *K*, which is prevented from revolving by the pilot end of the set-screw *L* projecting into the long slot in the work-holder. The head end of the work-holder is bored to receive the work, which is located by the shoulder *M* abutting against the stop-pin *N*. Inserted in the head end of the work-holder, at right angles to the bore for the work, is a cam *O*, which is operated by lever *P*. Spring *R* tends to rotate lever *P* and cam *O*, thus maintaining the pressure of the cam on the work.

In operation, the lever *P* is moved toward the turret until the head of the work-holder strikes the bushing *J*. Further pressure on the lever revolves



Turret Lathe Set-up for Accurately Turning Bevel on Valve A

cam *O*, and the work can then be placed in the holder against stop-pin *N*. When lever *P* is moved in the reverse direction, cam *O* grips the work. Further movement carries the work toward the revolving cutters. The work is guided into the bushing *H*, and then pressed toward the cutters until the front of the work-holder strikes the work guide bushing *H*. After this, the lever *P* is again moved toward the turret, and the work in the holder is replaced.

Gage *S* is used for setting the cutting blades, and the gage *T* is employed for the final checking of the work.

Fairfield, Conn. J. E. FENNO

Fig. 1. Spider Formed from Soft Brass

DIE FOR FORMING SPIDER PLATE

The spider plate shown in Fig. 1 is produced from soft brass, 0.051 inch thick, in three operations on a punch press. The first operation, which pierces the center hole and blanks and forms the piece to the shape shown in Fig. 2, is performed on a combination die of ordinary design. The second operation, in which the apertures are pierced, is also performed on a piercing die of the usual design. The die shown in Fig. 2, which is employed for the third operation is of special design. Before the work is formed by this die, it is annealed and cleaned with acid.

Referring to the construction of the forming die, Fig. 2, punch *A* is held in the punch-holder *B* by three screws. Within the punch *A* slides the sleeve *C*. The outside diameter of the lower end of this sleeve is 3/4 inch, and the inside diameter is the same as the outside diameter of the neck to be formed on the work. This sleeve serves a double purpose, namely, to hold the 3/4-inch part straight while the work is being formed on the down stroke and to prevent the die from drawing too much material from the center hole, which is needed to form the neck. In order to prevent excessive drawing at this point, the heavy spring *D* is placed in back of the sleeve.

The front face of sleeve *C* should be even with the inside corner of the tapered part of punch *A* when the upper end of sleeve *C* bears against the lower face of holder *E* at the end of the downward stroke. Within sleeve *C* is a sliding knock-out rod *F* which has a retaining cross-pin *G*. The end of punch *A* is required to hit the work a hard blow at the end of the stroke, in order to produce a flat smooth surface at the point indicated by *H* in the upper right-hand corner of Fig. 2. The holder *E* is therefore made of cold-rolled steel. The other parts of the die and punch are made of oil-hardening steel.

Die ring *I* is held in the die-shoe by equally spaced screws and, in turn, holds the center forming stake *J*. Within ring *I* there is a pad *K* which

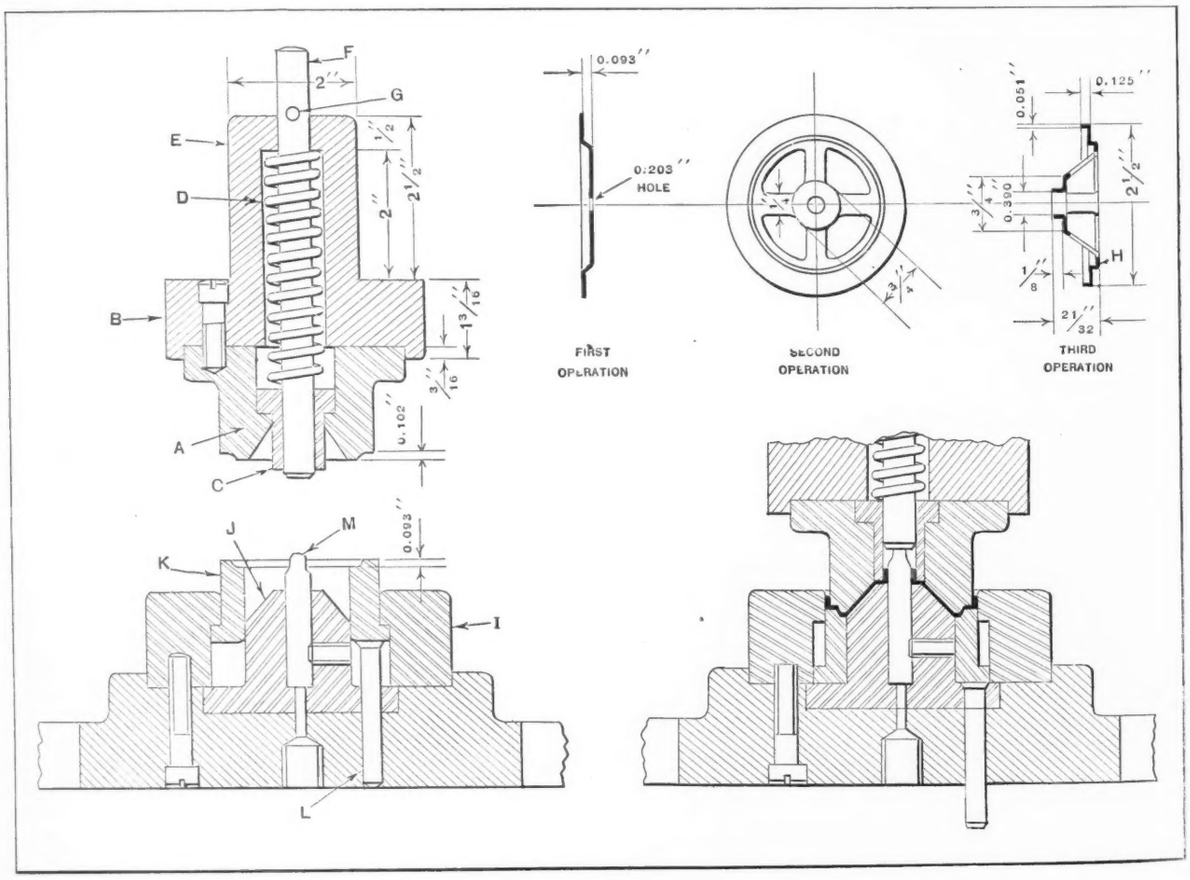
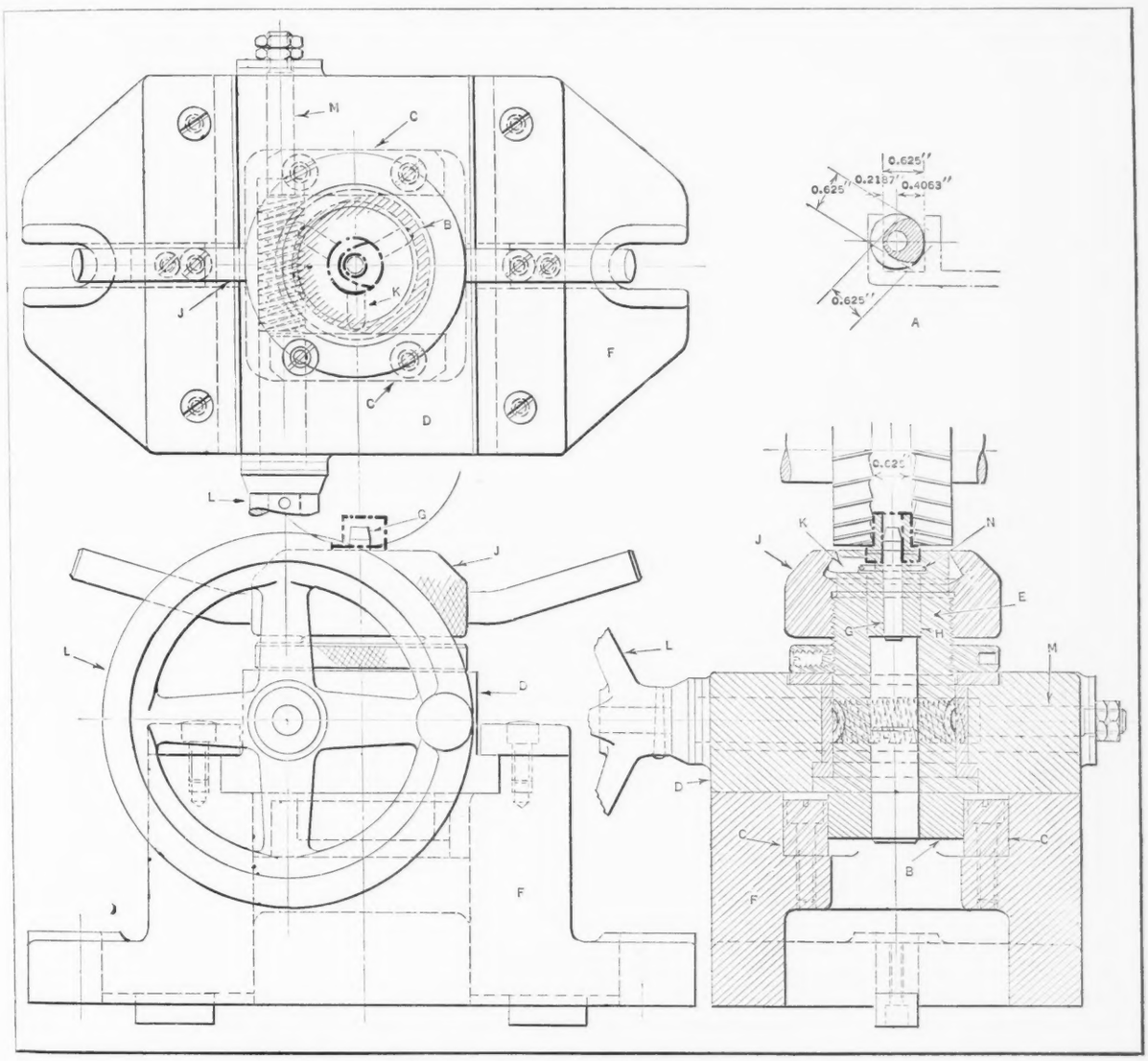


Fig. 2. Die Used for Final Forming Operation on Part Shown in Fig. 1

serves as a knock-out, as well as a drawing pad. The member *K* is normally held in the upward position by three pins *L*, which are backed up by the usual rubber bumper located beneath the die-shoe. The pin *M* which draws or forms the neck of the work is held in position in member *J* by a 5/16-inch headless set-screw.

The view at the left, Fig. 2, shows the die with the pad *K* in the top position, while the view at the right shows the punch and die in the positions they occupy at the extreme end of the downward movement. In order to form the piece to the shape indicated in the illustrations, it is necessary to draw the arms or ribs somewhat at points *R*, Fig. 1.

Cleveland, Ohio HERMAN SCHMID



Fixture Used in Milling a Cam with Straddle Milling Cutters

CAM-GENERATING FIXTURE

In making the cams for which the fixture here described was designed, it is possible to reproduce the same mechanical conditions that exist when the cam is in operation. The purpose of the cam is to give a reciprocating motion to a fork like that shown at *A*. Cams of this type, which fit between two faces, are the same width between all parallel tangential lines. This is important, as it is only when the cam fits the fork in all positions, that a smooth action can be secured. The spindle of the cam has a fixed center position, and in rotating, the cam lobe propels the fork back and forth a distance equal to the amount of the cam throw, which in this case is 3/16 inch.

By reversing this order in the fixture, the cam can be produced under the same conditions as exist when it is in operation, and therefore no doubt can arise as to its accuracy. To do this, the cam is rotated on its own center, the spindle being left relatively free, but with the fork held stationary. In rotating, the cam center is made to travel back and forth an amount equal to the throw of the cam.

The master cam *B*, which has the same throw as the cam to be produced, works between two hardened strips *C*, which take the place of fork *A*. This causes the slide *D*, which holds the locating plug *E* and the cam blank, to travel back and forth in the base *F*, which is bolted to the machine table.

The cam blank is a piece of round stock, which has been drilled, reamed, and faced in a previous operation. The blank is located on a pin *G* in the recess in *E*, and is supported at the correct height

by the plug *H*. The nut *J* is then tightened, and the three hardened and ground pins *K* are forced against the blank, holding it in place.

In operation, the milling machine table is fed forward until the center of the fixture is under the center of the arbor and between a pair of cutters mounted on the arbor. The cutters are spaced apart a distance equal to the width of the fork in which the cam will work. The table is locked in position, and the cam blank is rotated by means of the handwheel *L*, through the worm on shaft *M*, which meshes with the worm-wheel teeth cut in the periphery of the locating plug *E*.

Cam *B*, in revolving, moves slide *D* back and forth, carrying the cam blank forward and away from the cutters, and thus reproducing the throw and form of the master cam on the blank. At the end of the operation, the fixture is withdrawn from the cutters and nut *J* loosened. Clamping pins *K* are then withdrawn from the cam by the annular spring *N*, allowing the fixture to be reloaded.

Lafayette, Ind. P. A. NEWMAN

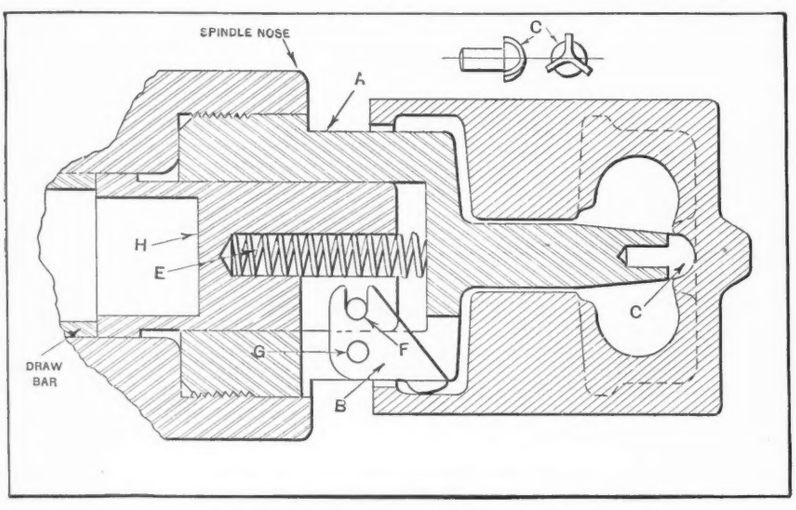
LATHE CHUCK FOR PISTON TURNING

The chuck shown in the accompanying illustration is used on a lathe for holding pistons of the type shown when rough-turning the outside. The body *A* of the chuck is threaded to fit the nose of the lathe spindle. In body *A* are three slots, spaced 120 degrees apart. Located in these slots are three jaws *B*, which are pivoted on pins *G*.

The adapter *H*, which is operated by the draw-in bar of the lathe, is also slotted and provided with pins *F* which engage slots in the rear ends of jaws *B*. The spring *E* normally tends to hold the jaws in their contracted positions.

The outer end of the piston is located and supported by a hardened steel button *C*, which is pressed into the outer end of body *A*. This button has three raised ribs, as shown in the side and end views above the piston. The skirt end of the piston is centered by the three jaws *B* which grip the work when the draw-bar is pushed to the right.

Rochester, N. Y. EDWARD T. HEARD



Chuck Used in Rough-turning Pistons

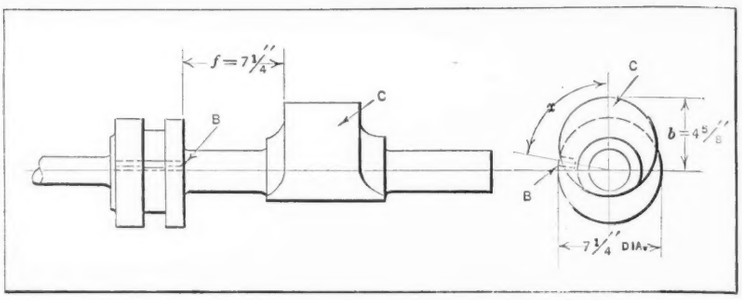


Fig. 1. Punch Press Camshaft

FINDING ANGLE BETWEEN SLOT AND CAM

In Fig. 1 is shown the camshaft which operates the ram of a punch press. The slot *B* in the clutch member is machined to receive a key, which can be moved by a special device, so that it either stands within the slot or projects a sufficient amount to enter the recess in the flywheel and thus engage the drive. When shafts of various makes and sizes are kept in stock, it is sometimes necessary to find the dimensions and operating characteristics of the shafts on hand, as well as the dimensions shown in Fig. 1. The angular position of the slot *B*, with relation to the position of the cam *C*, is the specification most commonly required.

The usual method of finding the angle *x* of the slot in relation to the cam is to place the camshaft on two V-blocks on a machined surface plate, and scale the heights *H* and *h*, Fig. 2. The difference between these measurements is then used in calculating angle *x*. It requires considerable time, however, to take the heavy parts to the surface plate, to line them up properly, and to make the required measurements. An easier method of finding angle *x*, when the surface plate and tools are not at hand, will be described here.

The dimensions indicated in Fig. 1 can, of course, be readily obtained. In addition to these dimensions, we need take but one other measurement, after which the desired angle can be quickly determined. This dimension is the straight distance *e* from the highest part of the cam at point *A* to the point *B* directly above the center of the slot, as shown in the view to the right, Fig. 2. Assuming that we find the dimension *e* to be 8.9 inches, we can compute the value of *c* by the formula,

$$c = \sqrt{e^2 - f^2}$$

Since *f* equals 7.25 inches we have,

$$c = \sqrt{8.9^2 - 7.25^2} = 5.162 \text{ inches}$$

The angle *x* can then be found by making a simple lay-out such as shown to the left, Fig. 2. The point *B* is located by striking an arc with a radius *c* from point *C*, which cuts the circle as shown.

The following explanation of the calculations involved may be of interest to some readers. The perspective view, Fig. 2, shows the relative positions of the triangles to be solved. In the right-angle triangle *ABC*, two sides are known, namely the side *f*, which equals the distance between the cam and the

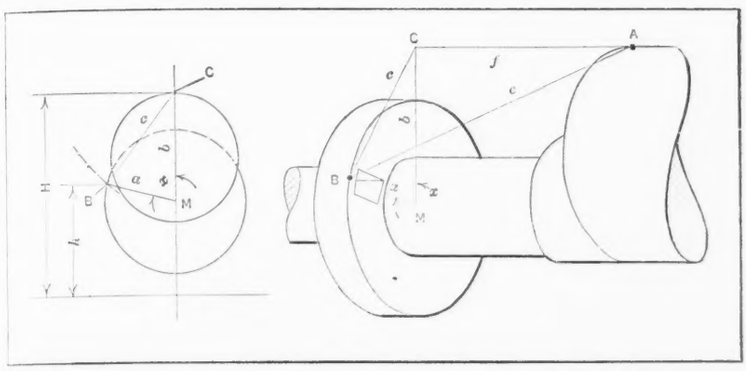


Fig. 2. Diagrams Used in Calculating Angle between Cam and Slot of Punch Press Camshaft

face of the slotted clutch member, and the hypotenuse e, which is measured as previously described. In this triangle, the third side c is calculated by using the formula already given.

With the side c known, we can find one side of another triangle in the plane of the slot. In the latter triangle BCM, we already know the length of the side MC, which is equal to the height b of the cam, and MB, which equals the radius of the part in which the slot is cut. With the three sides given, we can find the desired angle x in the usual way, by drawing a triangle having three sides equal, respectively, to the three given lengths, and then measuring the angle with a protractor.

It may be necessary to determine angle x very accurately, in which case we may employ the formula for finding the angle of an oblique-angle triangle when three sides are given, as follows:

$$\text{Cos } x = \frac{b^2 + a^2 - c^2}{2ab}$$

As we already have the equation $c = \sqrt{e^2 - f^2}$ we have, $c^2 = e^2 - f^2$. Substituting this term for c in the preceding formula,

$$\text{Cos } x = \frac{b^2 + a^2 - e^2 + f^2}{2ab}$$

In the given example, we have $a = 7.25 \div 2 = 3.625$; $b = 4.625$; $e = 8.9$; and $f = 7.25$. Substituting these numerical values in the formula,

$$\text{Cos } x = \frac{4.625^2 + 3.625^2 - 8.9^2 + 7.25^2}{2 \times 3.625 \times 4.625} = 0.2351$$

Thus the required angle x corresponding to cos 0.2351 = 76 degrees 25 minutes. Of course, the same method can be employed to locate the slot when machining the camshaft if other means are not available. This method can also be used in checking the accuracy of the finished part. The application of the method described is not confined to punch press camshaft problems. The example given, however, shows how the measuring or checking of an angle may be accomplished by making a linear measurement and performing some simple calculations. When the principle is once understood, the reader will find applications for this method of checking angles on such parts as automobile engine camshafts, pump crankshafts, and similar parts.

Detroit, Mich. HANS GOLDSCHMIDT

OBTAINING THE BEST RESULTS FROM PENCIL TRACINGS

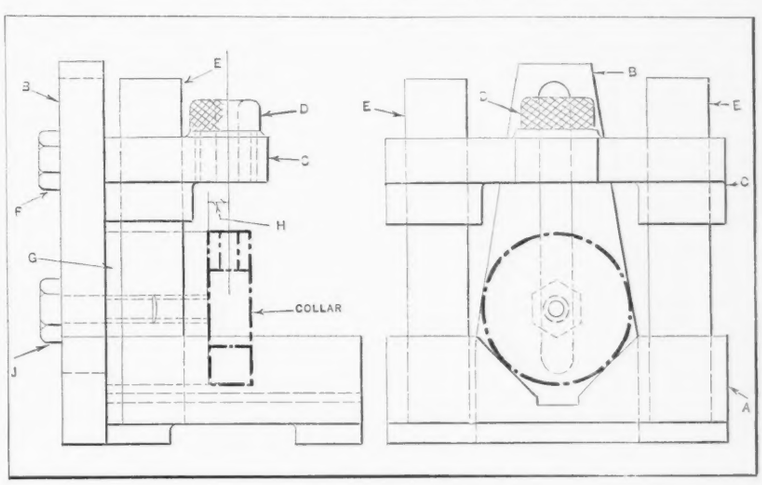
The suggestion on page 91 of October MACHINERY that carbon paper be placed at the back of pencil tracings to produce darker lines, better adapted for making blueprints, may seem all right theoretically, but in actual practice it has been found to have some faults. It is difficult to obtain carbon paper in sheets large enough to suit the size drawings used in many drawing-rooms, and shifting the paper so that the whole surface may be covered is likely to cause inaccuracies. Then, too, the tracing must be lifted when making erasures to prevent smearing, and there is the additional work of erasing the lines on the back of the tracing cloth. Also, carbon-backed tracings become smeared by handling. Blueprints from such tracings must be made by sun exposures, as the heat from the powerful arc lights of blueprinting machines causes the wax base of the carbon lines to melt and smear the back of the tracing.

Tests have shown that to produce good blueprints from pencil tracings, the following instructions should be observed: (1) Use tracing cloth of proper transparency, which takes a pencil line well and is not affected by erasures. (2) Bear in mind that the 7-H pencil ordinarily used on manilla paper is unsuitable for tracing cloth. The best results have been obtained by using an HB or F pencil, which gives a dark line but one that does not smear the tracing. (3) Remember that underexposure gives the print a faded effect and overexposure gives it a burnt appearance.

Philadelphia, Pa. S. UDO

ADJUSTABLE JIG FOR DRILLING COLLARS OF VARIOUS SIZES

We had a lot of collars of various diameters and widths in which radial holes of different sizes were to be drilled. The quantity required was not suffi-



Jig for Drilling Radial Holes in Collars of Various Sizes

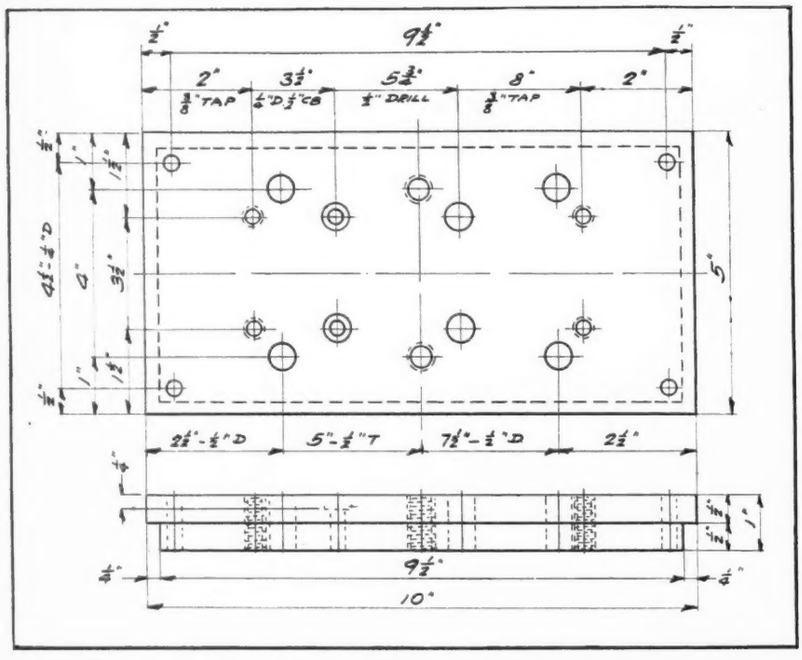


Fig. 1. Proposed Dimensioning System Applied to Drawing of Cover Plate

cient to warrant making a drill jig to suit each diameter, width, and size of hole. To meet these conditions, an adjustable jig was designed, which would accommodate any of the collars to be drilled.

As shown in the accompanying illustration, the jig has a V-block base *A*, to the back of which is fastened a vertical plate *B* in which there is a long vertical slot. A plate *C*, which can be raised or lowered on the pillars *E*, carries one of the interchangeable drill bushings *D*. The plate *C* may be held at the desired height above the work by bolting it to the plate *B* by means of screw *F*, which extends through the vertical slot.

A spacer *G* of the proper thickness is provided for each width of collar to be drilled, in order to locate the radial hole half way between the parallel faces of the collar. The size corresponding to the distance *H* is stamped on each spacer. It was intended that the work be held against the spacer by hand, but later it was found necessary to clamp the work in place. This was done by clamping a strap across the outer face of the collar, with a cap-screw inserted in the tapped hole extending through the spacer *G*. It was possible to do this without making any further changes in the jig, as the screw *J* extends only part way through spacer *G*.

WALTER E. GUNNERSON
Rockford, Ill.

DIMENSIONING DRAWINGS

The method of dimensioning employed in the detailed drawing of a cover plate, Fig. 1, represents a departure in several respects from the conventional methods of the drafting-room.

The variations from the usual practice are tabulated as follows:

1. Dimension lines are continuous; a time-saving kink that is coming into widespread use.

2. Arrow points of dimension lines are slanted in accordance with the slant of the lettering to improve the general appearance of the drawing without involving additional work.

3. No dimensions are given on the part shown in the drawing, a practice which is now followed in some drafting-rooms whenever possible.

4. The lay-out is simplified by giving adequate dimensions from the lay-out edge, omitting the arrow points, as shown, except in the case of the final dimension, which serves as a check.

The practice outlined in (4), which is in actual use, enables the machinist or draftsman to lay off all the dimensions on one line without changing the position of his scale. As a result, greater accuracy is obtained with less effort. The operation to be performed at the point indicated by any given dimension is noted at that point. For instance, at the upper side of the drawing, the point indicated by the 3 1/2-inch dimension taken from the left-hand end of the piece has a brief note which indicates that a 1/4-inch hole is to be drilled, and counterbored with a 1/2-inch counterbore. The depth of the counterbore may be given also if space permits. It may also be necessary to know the distance between centers. The man in the shop should not be expected to do any calculating, and hence, all dimensions he may need should be given.

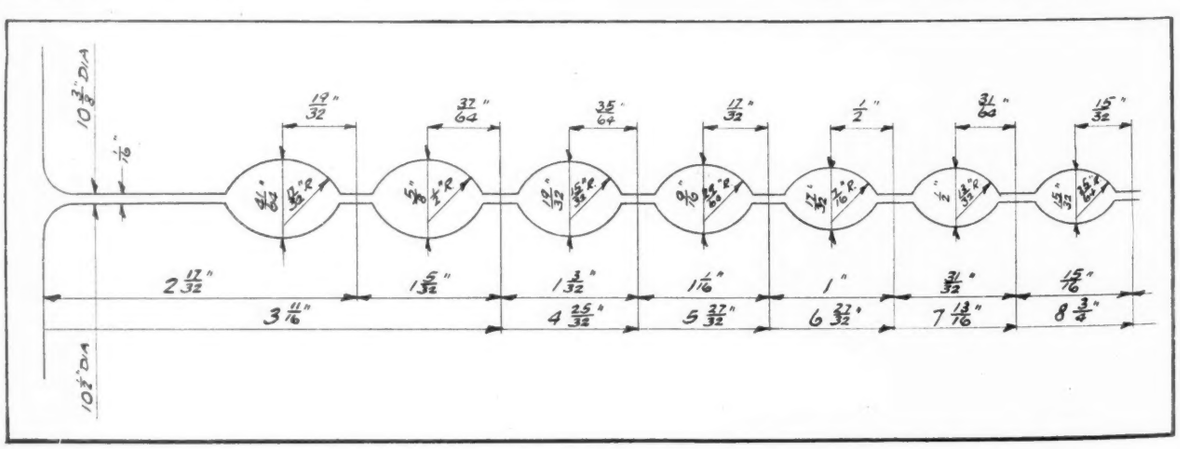


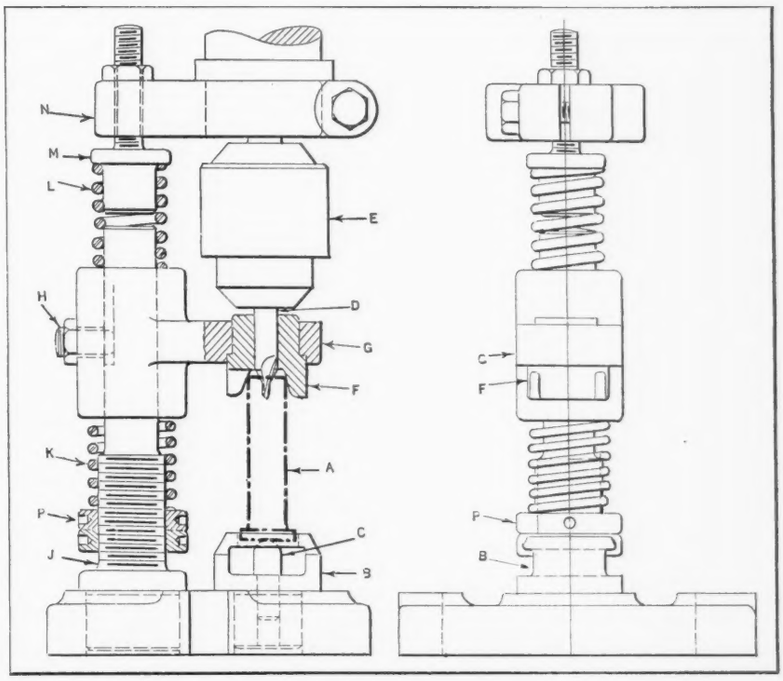
Fig. 2. Application of Proposed System of Dimensioning to Drawing of Grooves in Rolling Mill Rolls

In some cases, it will be necessary to show both dimensions, as illustrated in Fig. 2. This drawing shows the details of the grooves of a roll for a 10-inch mill. Even in this case, the drawing would be fairly complete without the center distances, but the roll turners find that the center distances are desirable on drawings of this kind. The writer would be interested in any comments on the methods described, especially the one outlined in paragraph (4).

Catasauqua, Pa. E. B. PAYSON

FIXTURE FOR CENTER-DRILLING

A centering tool arrangement for quickly and accurately center-drilling small parts, which has given a production of from 800 to 1000 pieces per hour, is shown in the accompanying illustration. The fixture is applied to a small high-speed drilling machine.



High-speed Drilling Machine Equipped with a Quick-acting Center Drilling Fixture

The work, shown at *A*, is set in the recess of the work-holder *B* and rests on the button *C*. The recess in *B* is slightly larger than the work. The combination center drill *D* is held in a standard chuck *E*, which is mounted in the spindle of the drilling machine. When the spindle is lowered, the center drill passes through the combined drill guide bushing and work-centering cup *F*, which has three slots in it for chip clearance. This cup is a press fit in the projecting arm of the member *G*, which slides on the post *J*. Member *G* is limited in its vertical movement by the screw *H*, and is held in sliding suspension between the two springs *K* and *L*.

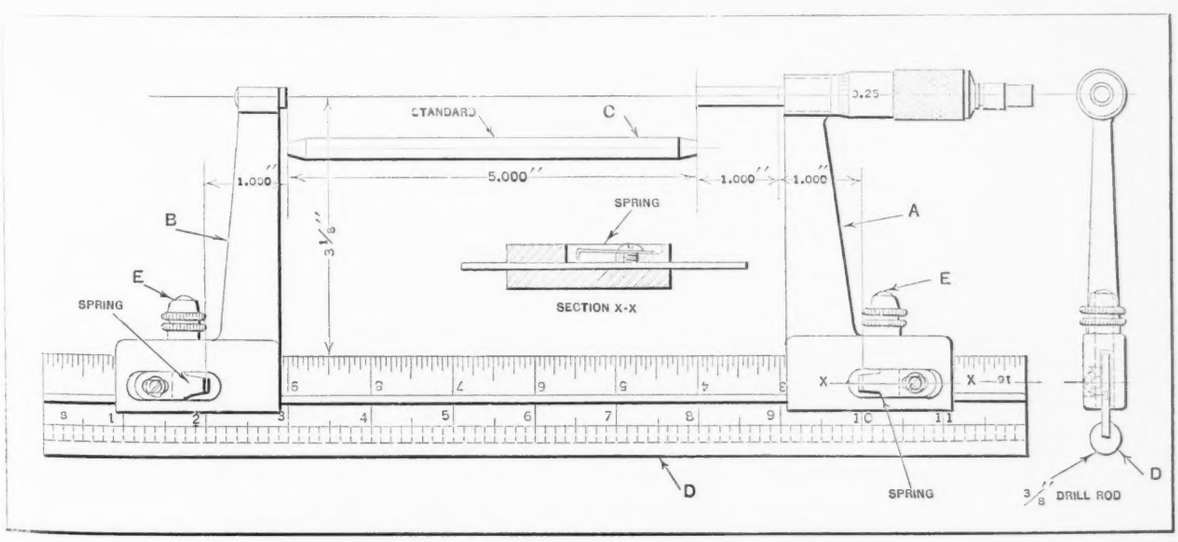
When the machine spindle is raised, spring *K* forces the bushing holder *G* upward. When the spindle is lowered for drilling, spring *L* is depressed by the part *M*, which is threaded to the link *N*, the latter, in turn, being clamped to the machine spindle. The relative tension on the springs *K* and *L*, on which depends the centering of the work before the center drill begins to drill, is adjusted by the lock-nuts *P* and the adjustable attachment of *M* in the link *N*.

Racine, Wis. HOLGER B. LARSEN

MICROMETER MEASURING HEADS FOR COMBINATION SQUARE

The accompanying illustration shows a combination square blade equipped with micrometer heads, which can be easily made by a machinist or toolmaker. The micrometer barrel and mandrel are purchased ready made and fitted to the head *A*, which is made of machine steel. This head and the head *B* are slotted to fit a 12- or 18-inch combination square blade. The conventional type of hook-screw *E* is used for clamping the heads in position.

An opening is cut through one side of each head



Combination Square Blade Fitted with Micrometer Heads

as shown. In this opening is located a spring, as shown in the section *X–X*. The spring is a close fit in the opening and serves as an index for setting the head from one inch mark to another, the wedge-shaped end of the spring being shaped to fit in the graduation lines.

The standard bar *C* is used in locating the micrometer head in the correct or zero position while adjusting the indexing spring to fit properly in one of the inch lines. The 3/8-inch slotted drill rod *D* serves to straighten and strengthen the blade. The completed micrometer is very substantial and is as accurate as the graduations on the scale. Standard or test bars can, of course, be employed to obtain very accurate adjustments.

Worcester, Mass. C. W. PUTNAM

THE BOLTS THAT DID NOT FAIL

In looking over some old field notes recently, the writer happened upon an item that may interest readers who are speculatively inclined. In making changes in the installation of an automatic, it was necessary to remove the old overhead works. This consisted of the customary countershafts and hangers bolted to a timber crib work or framing. The framing had been fastened by 5/8-inch rough iron bolts to the concrete ceiling, the bolt heads engaging the bolt head sockets commonly employed in concrete mill construction. To the writer's knowledge, this framing had been in place for two years at least, and probably longer.

Upon removing the bolts that supported the crib work, it was found that all the bolts had a fracture extending anywhere from a third to half way across under the head. The writer will never forget the expression on the operator's face when he observed the fractured bolts. For months he had been standing under this rig which was supported by the fractured bolts.

Now if the whole area of the bolt was insufficient to support the structure without becoming fractured, how could 50 or 60 per cent of the area be sufficient? Again, why did not the bolts start to fail at the root of the thread? It should be added that the bolts were of adequate cross-section, theoretically, for the duty imposed upon them and the resilience of the frame would prevent any serious shifting of the load. The heads and head sockets were examined for uneven bearing, which might induce secondary bending strains, but there appeared to be nothing wrong in this respect.

F. A. H.

[Could it be possible that the bolts were fractured before being used, either when the threads were forged or by improper clamping when cutting the threads in a bolt threading machine? Then, again, could not fractures of the kind described have resulted from some accident after the installation was made, such as might possibly occur in moving heavy machinery or in the winding up of a broken belt?—EDITOR]

MILLING PISTON-PIN BOSSES

Numerous fixtures have been devised for use in milling the inside ends of piston-pin bosses. The one shown in the accompanying illustrations is used in a shop doing motor reconditioning work on a large scale. Most of the pistons used for repair work in this shop are machined from rough castings.

The details of the milling device are shown quite clearly by the two illustrations. In Fig. 1, *A* is a cast-iron fork used to secure the mechanism to the milling machine arbor. The driving sprocket *B* is mounted on the milling machine arbor in exactly the same way as an ordinary milling cutter. The milling cutters that face the inside ends of the bosses are driven by a chain *C*, which drives the sprocket *D*, Fig. 2, mounted on the cutter-arbor. This arbor is carried on the end of the member *E*, Fig. 1, which is free to slide in bracket *F*, when the table is fed forward. The threaded spanner collar *G* on sleeve *H* provides adjustment for taking up slack in the sprocket chain. After adjusting the sleeve to give the proper tension to chain *C*, the clamp screw *J* is tightened.

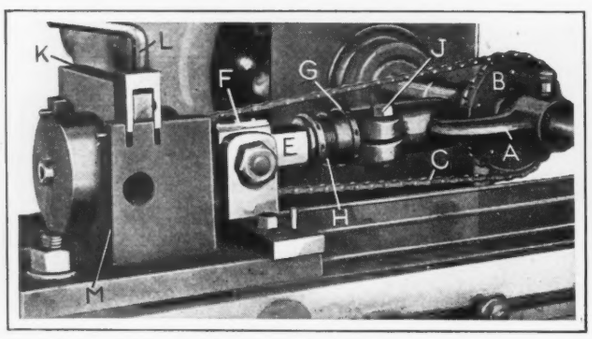


Fig. 1. Attachment for Milling Piston-pin Bosses

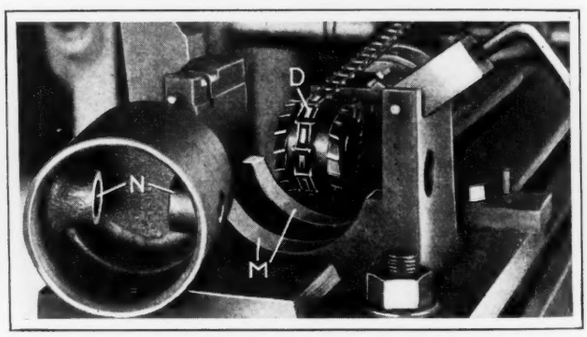


Fig. 2. Attachment Shown in Fig. 1, with Work Removed

The piston is held in a cradle *M* by means of the formed bar clamp *K* and the screw *L*. A piston is shown locked in place in Fig. 1, while Fig. 2 shows the piston removed from the cradle. The milled inside ends of the bosses on the piston removed from the device are shown at *N*, Fig. 2. The cutter-arbor is made narrow enough to permit the milling cutters to be properly set for milling connecting-rods having the minimum width between bosses. The cutters are set for wider spaces by placing thin washers back of the inner hubs or sides of the cutters.

La Grange, Ill. AVERY E. GRANVILLE

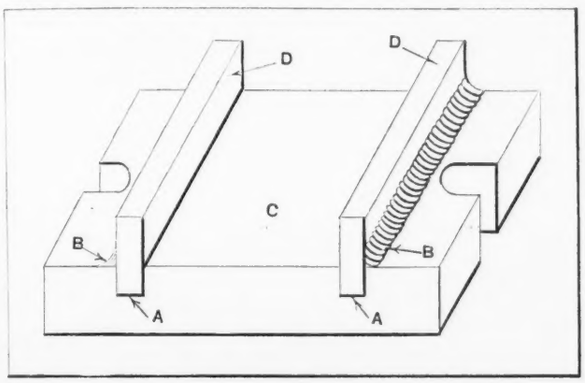
* * *

There are now 4,000,000 automobiles registered in the world, outside of the United States.

Shop and Drafting-room Kinks

DIE-SHOES OF WELDED CONSTRUCTION

The practice followed in some shops of making die-shoes from solid blocks of metal is, in the writer's judgment, seldom necessary. Many shops



Die-shoe of Welded Construction

use steel castings, and while these cost less than a solid block of steel, they are more difficult to machine. In shops where welding torches are available, die-shoes can be made at great savings.

If the keys *D* are properly fitted, as shown at *A* in the illustration, and welded as shown at *B*, there is no reason why the shoes should not be as serviceable as when made from solid steel or from steel castings. The writer has never known the keys to come loose when welded in place as shown. With the welded method, a piece of machine steel, as shown at *C*, with two keyways milled in it and fitted with machined or cold-rolled strips *D*, is all the material required. This obviously means a considerable saving in the material cost.

Philadelphia, Pa. C. KUGLER

SUPPORTING LONG WORK WITH JACK

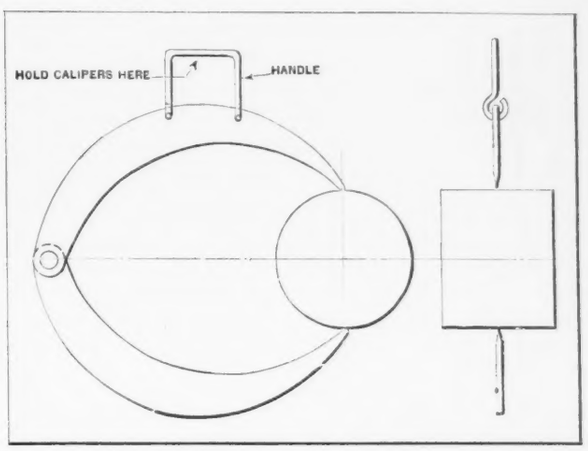
Many times when drilling long pieces in a drilling machine, it is necessary to support the outer end of the piece in some way. Generally an old box or two, with a few short pieces of board or a piece of iron, are used to block up to the right height. However, for occasional jobs, a jack used as shown in the illustration has been found satisfactory. A screw jack will give a more exact adjustment when this is needed, but for all ordinary purposes a lever jack is suitable.

Jack Used to Support Outer End of Long Part while Drilling

La Grange, Ill. AVERY E. GRANVILLE

ALIGNMENT HANDLE FOR LARGE CALIPERS

Considerable care must be taken in measuring large-diameter work in the lathe to see that the calipers are square with the axis of the job. If they are not, a false measurement will be shown. It is not difficult to hold the smaller sizes of calipers square in the ordinary way, but large calipers are awkward to handle and it is hard to see when both



Handle for Large Calipers to Assure Proper Alignment

legs are square. The writer fitted a handle to a big pair of calipers, and found it well worth the making to insure correct measurement. First, two holes were drilled in one of the caliper legs, and then the handle, made of 1/8-inch rod, was fitted in. The handle is quite loose in the holes, so that when the calipers are picked up they assume a true vertical position.

Hamilton, Canada A. KENDALL

* * *

The Bureau of Education of the Department of the Interior recently announced that the enrollment in the 148 engineering schools in the United States has increased from 62,312 in the year 1926-1927 to 65,520 in 1927-1928. The Massachusetts Institute of Technology ranks first in the number of enrollments, with 2250 students, closely followed by Purdue with 2226. The professional grouping shows over 20,000 students taking electrical, 14,000 civil, and 11,000 mechanical engineering. About 6000 are taking chemical engineering, and over 2000 mining and metallurgy; 614 students are enrolled in aeronautical courses.

Questions and Answers

CEMENT FOR WATER-COOLED WELDING ELECTRODES

W. E.—We frequently need some kind of cement, or a material that can be used in place of a cement, in the assembling of tips for certain electrodes or fittings that screw into the electrodes. The electrodes are of copper, and the fittings and tips are of the same material. Often we find it necessary to make special electrodes that require threaded joints. These electrodes are usually of the water-cooled type, and we experience difficulty at times in obtaining an absolutely water-tight joint, the water pressure sometimes being as high as 60 pounds per square inch. This difficulty is especially noted when we are using straight threads bottoming in the adjacent part.

We would like to obtain information about a cement that would be waterproof and at the same time able to resist a high temperature.

LEASED MACHINERY

L. F. G.—Recently we leased to a buyer a machine on a written contract by which he agreed to pay $500 deposit and $500 each month for ten months. At the end of the ten months, the buyer was to have an option to return the machine, or pay us $5 purchase price for it. After nine months the buyer became insolvent. His creditors have attached the machine on the grounds that this lease contract legally is a sale. What is the law in a case of this kind?

Answered by Leo T. Parker, Attorney at Law, Cincinnati, Ohio

In a recent case, (115 So. 285) a bottling company purchased a filling machine for a rental of $6000. The sum of $900 was paid upon delivery of the machine, and the balance as rental in eighteen monthly installments. It was stated in the contract that after payment of the last installment, the bottling company was to have the option to purchase the apparatus upon the further payment of $1. Eight months later, a receiver, who was appointed for the insolvent purchaser, proceeded to offer the machine for sale to satisfy the creditors of the company. The seller filed suit, contending that since the bottling company had failed to pay the rental for the last ten months, and had not paid the $1 purchase price, the transaction was legally a lease and not a sale, whereby the property was not subject to sale by the receiver. However, the Court held the contract to be a sale and not a lease, which prevented the seller from reclaiming the machine.

In other words, the Court looks through the phraseology of contracts of this kind to determine whether the parties intended a sale or a lease. Obviously, where the purchaser finally may purchase a $5000 machine for $5, it is easy to determine that the original intentions of the parties were to make a sale. However, if you sell a machine on the installment monthly plan and reserve the title in the machine to yourself, until fully paid for, and record *the bill of sale*, you may repossess the machine if the purchaser fails to meet the agreed payments.

FAILURE TO WEAR SAFETY APPLIANCES

K. M.—The rules of a manufacturing plant require that employes wear goggles when cutting rivets, and the plant furnishes goggles for this purpose. An employe, while cutting rivets without the use of goggles, was struck by a flying rivet head and lost his eye. The employe was acquainted with the rule, and knew that goggles for his protection were at hand, but declined to use them on the ground that he could do the work better without them. May the employer escape liability for this accident under a workmen's compensation statute that provides that no compensation shall be paid for injury caused by a willful failure of an employe to use safety appliances?

Answered by Leslie Childs, Attorney at Law, San Diego, Calif.

Probably yes. When the employe followed his own judgment as to the necessity of wearing goggles, in plain violation of a rule of his employer with which he was acquainted, his conduct amounted to willful disobedience. According to the weight of authority willful disobedience will relieve an employer from liability for injury suffered by an employe. (269 S. W. 919.)

AVOIDING UNDER-CUTTING ON SMALL WORM-GEARS

A. M. G.—Is there any way of avoiding the under-cutting of the teeth of small worm-gears, which occurs when a wheel blank of standard size is cut in the usual manner with a 29-degree hob?

A.—Two methods of avoiding under-cutting of this kind are described on page 274 of MACHINERY'S book "Gear-cutting Processes" as follows:

One way to avoid this under-cutting is to enlarge the worm-gear blank, as is done frequently when small spur pinions are made. The following Brown & Sharpe formula gives the throat diameter of an enlarged worm-gear blank:

$$O = D \times \cos^2 14\ 1/2^\circ + 4S$$

In this formula, O = throat diameter; D = pitch diameter; and S = addendum.

If the same center distance is to be maintained, the worm diameter is reduced as much as the throat diameter is increased. Another method of avoiding under-cutting is to increase the angle of the worm thread. The following formula, in which N equals the number of teeth in the worm-gear, is used for determining this increased angle:

$$\text{Cos } 1/2 \text{ worm thread angle} = \sqrt{1 - \frac{2}{N}}$$

This change would involve making either a hob or a fly cutter of corresponding angle.

The Machining of Vulcanized Fiber

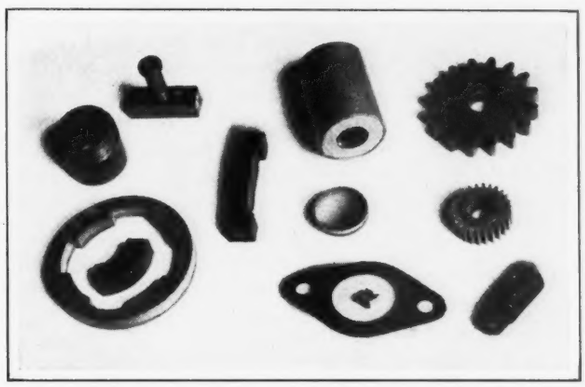
The Machining of Fiber Presents Many Difficulties Unless Certain Easily Followed Directions are Observed

By N. S. BAER, Wilmington Fiber Specialty Co., Wilmington, Del.

THE term "fiber" is used to designate various products that are entirely different and unrelated. The fiber referred to in this article is more commonly known as "vulcanized fiber" to distinguish it from numerous other fibrous products. It should not be confused with fiber such as is used for containers and shipping cartons, pails, furniture, or laminated phenolic resinous materials.

Vulcanized fiber is made by converting cotton rags into thin sheets resembling paper, which by means of a chemical bath and chemical reaction are transformed into a homogeneous mass. The time required for its manufacture varies with the thickness of the finished sheet, the heavier thicknesses requiring one and one half to two years from the beginning of the process until ready for the market.

The finished product is tough, dense, and homogeneous, and improves with age. It is slightly resilient and is made in varying degrees of hardness to meet the requirements of different applications. The standard colors are red, gray, and black and are uniform throughout. It can be provided in a flexible form if required. It does not crystallize when subjected to severe vibration. It is insoluble in ordinary solvents, and is uninjured by contact with or immersion in alcohol, ether, ammonia, turpentine, naphtha, benzine, petroleum, and similar solvents.



A Few Parts Made from Vulcanized Fiber

Fiber is Available in Many Shapes and Sizes

Fiber is made in the form of sheets, rods, and tubes. The sheets vary in size from 44 by 66 inches to 50 by 80 inches, and in thickness from 0.004 inch up to 2 inches. Tubes vary from 1/8 inch inside diameter upward, and in wall thickness from 1/64 to 1/4 inch. The wall thickness depends upon the inside diameter of the tube, a larger thickness being possible with the larger tubes. Rods are made from sheet fiber; they are furnished from 3/32 inch to 2 inches in diameter and vary in length according to the sheet from which they are made.

Approved Methods of Machining Fiber

Fiber may be sawed, punched, turned, broached, drilled, milled, tapped, threaded, shaved, and formed. Owing to certain peculiarities of fiber, hard and fast rules for working this material cannot be laid down. The detailed machining methods are largely dependent upon the specifications of the finished piece. There are numerous special jobs of machining that require special tools to effect real economy. Also, in many cases, long experience on the part of both the foreman and the operators is essential in fabricating fiber articles and parts. Accordingly, what follows should be considered in the light of suggestions rather than explicit directions.

The machinist should first be cautioned against the possible misconception that because fiber is softer and less tough than most metals, tools will stay sharp indefinitely when used for machining this material. Two general rules should be kept in mind in machining fiber: (1) Keep tools sharp; and (2) allow sufficient clearance. Tools for working fiber should be ground about the same as tools for working brass.

Cutting Speeds for Sawing Fiber

Fiber can be sawed either with a circular saw or a band saw. For band saws, the speed should be between 4500 and 5000 feet per minute. Circular saws should run between 10,000 and 12,000 feet per minute. A circular saw should be resharpened every fifteen to thirty minutes, depending upon the thickness of the stock, which varies from 1/8 to 1 inch. Band saws, however, will run successfully for thirty minutes to one and one-half hours without resharpening. Band saws should be reset at least once every day.

Punching and Shaving Fiber

Blanking, piercing, and shaving of fiber can be done on ordinary punch presses. Fiber up to 1/4 inch thick can be punched, but work over 1/8 inch thick will be somewhat rough on the edges. Checking is likely to result when punching fiber more than 1/4 inch thick, although this can be partially overcome by heating. For stock more than 3/16 inch thick, the fiber should be heated to 130 degrees F. To obtain smooth edges on fiber blanks, it is necessary to blank the stock a little larger than the required size and smooth with a shaving die. Blanks less than 7/16 inch thick should be shaved cold; thicker blanks should be heated.

Turning and Boring Fiber

The turning of fiber has not been standardized, as the methods favored by manufacturers vary with conditions; the surface speed varies all the

way from 60 to 360 feet per minute, with the feed per revolution ranging from 0.006 to 0.030 inch for a 1/8-inch depth of cut. At high speeds, tools dull quickly, necessitating frequent regrinding. Owing to the resiliency of the material, considerable care must be exercised in order to keep within the limits of the dimensions specified. Boring methods vary widely. Diamond cutters are often used in boring this material.

Drilling, Tapping, and Threading Fiber

Drills used on fiber soon become dull and should usually be ground after ten to fifteen minutes of use. The most satisfactory results are obtained by using sharp drills run at high speed, with the least possible pressure. Care must be exercised, however, not to allow a drill to run so fast as to burn the material.

The use of a larger size tap drill than is used for cast iron or steel is necessary to insure a full thread in fiber. The proper size can best be determined by drilling a few test holes. Regular taps give a good thread in fiber and several thousand holes can be tapped with some sizes of taps. Good threads can be cut in fiber with ordinary dies. The best results, however, will be obtained by the use of self-opening dies and chasers.

Milling and Planing Fiber

Many mechanics have found it good practice in milling fiber to remove all the material in one cut if possible. High speed and fast feed usually give the best results. This also throws the chips clear of the work.

In planing, a cut of 1/16 inch or more at high speed with a coarse feed has been generally found to be the best practice. There are numerous exceptions to this rule, however, which make it advisable to rely largely on experience as a guide in planing this material.

Bending and Forming Fiber

Fiber can be bent and formed into relatively simple shapes. The fiber is bent and formed in steam-heated forms after it has been softened by immersion in hot or cold water or by steaming. Fiber should be bent with the grain, as there is risk of breaking if it is bent across the grain. Special equipment and skill are essential in forming and bending fiber.

Use of Automatic Machines in Cutting Fiber

A large number of products are made of fiber on automatic screw machines. In general, it is good practice to run an automatic screw machine at a spindle speed of 1200 revolutions per minute for cuts of depths up to 1/8 inch and with a feed of 0.006 to 0.015 inch per revolution. Rods and tubes are well adapted for machining on automatics. The work, however, requires experienced operators.

Reaming any kind of fiber is not practicable for several reasons, one of which is that the holes cannot be reamed accurately to size, and another, that the reamer is rapidly dulled.

Coefficient of Friction of Fiber and Other Materials

The coefficients of friction between fiber and several other materials are as follows:

Material and Character of Surface	Coefficient of Friction
Fiber on fiber, dressed with smooth-cut file	0.162
Fiber on white pine, wood-planed and sandpapered; fiber dressed with smooth-cut file	0.179
Fiber on cast iron; cast iron machined; fiber dressed with smooth-cut file	0.139
Fiber on mild steel; steel machined; fiber dressed with smooth-cut file	0.130

Physical Properties of Fiber

The physical properties of fiber are as follows: Tensile strength, 12,000 to 15,000 pounds per square inch with the grain; compressive strength, 38,000 to 42,000 pounds per square inch; shearing strength, 9000 to 13,000 pounds per square inch; elastic limit (average), 4000 pounds per square inch; specific gravity, 1.36 to 1.46; active combustion begins at 650 degrees F.; dielectric strength, 200 to 400 volts per mil of thickness.

Because of these unusual physical properties, fiber has numerous applications. Only a few uses are mentioned here in order to give an idea of the type of products made of fiber. It is used for gears and pinions, shims, bushings, clutch disks, cams, thrust and bearing washers, as well as washers and gaskets for other purposes, bearing spacers, condenser ferrules, lever handles, pulleys, wheels, and numerous other products, such as washers and gaskets for the plumbing industry, bobbin and spool heads, rollers and casters, tool-room tags, time checks, shoe patterns, and vacuum cleaner accessories.

In addition to the foregoing, there are many other applications requiring electrical insulation qualities as well as mechanical durability.

* * *

GERMAN AIR TRANSPORTATION

There are today seventy-six regular air lines in Germany, including national and international lines. On all these lines there is at least one airplane a day operating in each direction, except on Sundays. Eighty-one cities in Germany are regularly connected by air lines. The most important air transportation centers are Berlin and Cologne. The German air lines receive a large appropriation for carrying mails, paid partly by the German Government and partly by certain German cities. This sum, amounting to $6,500,000 in 1927, covered about 70 per cent of the total expense of operation and maintenance of the air service; the other 30 per cent came from income from freight and passenger service. The passenger fares are about the same as the first-class fares on express trains.

Only two air lines in Germany are sufficiently lighted for night flying—the Berlin-Koenigsberg and the Berlin-Hanover lines. It is stated that within the next two years regular service will be established between Berlin, Moscow, and Peking. Experimental flights over that route have already been made, and negotiations with the governments concerned are now under progress. The Berlin-Peking route represents one of the longest railroad journeys in the world, and thus demonstrates the time that can be saved over long distances. The railroad time is twelve days; the first flight by commercial airplanes required but seventy flying hours.

Formula for Worm and Spiral Gear Train

A Method of Obtaining the Required Dimensions When a Regular Worm is Designed to Run with a Spiral Gear

By W. E. TRASK

OCCASIONALLY it is necessary, to design a worm to run with a spiral gear and to use a standard diametral pitch hob, already in stock, for cutting the gear. This arrangement of a spiral gear driven by a worm is required, for instance, where lateral adjustment of the spiral gear or its actual removal from the shaft must be accomplished without disturbing the worm. An example of this kind is a compressor unit where the worm is cut on the shaft on which various impellers and armature windings are assembled.

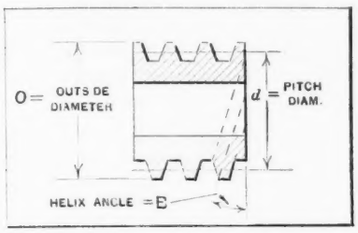


Diagram Used in Calculating Helix Angle of Worm

Of course it is always a question when a worm ceases to be a worm and becomes a spiral gear, and vice versa. If we call the worm a spiral gear, the spiral gear formulas on page 720 of the sixth edition of MACHINERY'S HANDBOOK may be applicable, but if we call it a worm, there appear to be no formulas for worm-gear design that we can readily apply. Briefly, the problem of designing the worm hinges on the calculation of the spiral or helix angle. Having given the number of threads n in the worm, the pitch diameter d and the normal diametral pitch P_n of the hob used in cutting the teeth of the spiral gear, we can obtain the helix angle B by means of the formula,

$$\text{Sin } B = \frac{n}{P_n \times d}$$

The helix angle B, thus found, is the angle between the thread and the face of the worm, as indicated in the accompanying illustration, and in the case of a spiral gear, it is the angle between the tooth and the axis of the gear.

The problem is to design a worm and spiral gear of an even normal diametral pitch, when we have given the ratio required; the normal diametral pitch; approximate outside diameter of worm; and the center distance.

Example—Find the helix angle B, as indicated in the illustration, when the ratio of the speed of the worm and the spiral gear is 20 to 1, the normal diametral pitch P_n equals 20, the outside diameter O of the worm is approximately 1.5 inches, and the center distance between the worm shaft and the gear shaft is between 3 1/2 and 4 inches.

Pitch Diameter of Worm and Gear

First we obtain the pitch diameter d, which equals the outside diameter minus twice the addendum or $d = 1.5 - 0.1 = 1.4$ inches.

The approximate pitch diameter D of the spiral gear is obtained by means of the formula,

$$C = \frac{D + d}{2} \text{ or } 2C = D + d$$

in which

C = center distance;
D = pitch diameter of spiral gear; and
d = pitch diameter of worm.

Assuming a center distance of 4 inches, we have by substitution in the preceding formula,

$$8 = D + 1.4 \text{ and } D = 6.6 \text{ inches}$$

or assuming a center distance of 3.5 inches,

$$7 = D + 1.4 \text{ and } D = 5.6 \text{ inches}$$

Number of Teeth in Gear and Threads in Worm

Assuming that the spiral gear is approximately 6 inches in pitch diameter, we have the number of teeth N in the gear equal to the pitch diameter times the diametral pitch, or $6 \times 20 = 120$ teeth.

Since a ratio of 20 to 1 is required, we have $120 \div 20 = 6$ teeth in the worm.

Helix Angle of Worm

The helix angle B of the worm thread is obtained by the formula,

$$\text{Sin } B = \frac{n}{P_n \times d}$$

Substituting numerical values, we have:

$$\text{Sin } B = \frac{6}{20 \times 1.4} = 0.2143$$

The helix angle B corresponding to sin 0.2143 is 12 degrees 22 minutes.

Lead and Linear Pitch of Worm

With the helix angle known, it is a simple matter to obtain the lead l from the formula:

$$\text{Cot } B = \frac{3.1416d}{l}$$

given in the sixth edition of MACHINERY'S HANDBOOK, page 690.

From this formula we have:

$$l = \frac{3.1416d}{\cot B}$$

Substituting numerical values,

$$l = \frac{3.1416 \times 1.4}{4.5609} = 0.9643 \text{ inch}$$

Specifications for Worm

$$\text{Linear pitch } P = \frac{l}{n} = \frac{0.9643}{6} = 0.1607 \text{ inch}$$

Therefore, the specifications for the worm are:

n = number of threads per inch = 6;
d = pitch diameter = 1.4 inches;
O = outside diameter = 1.5 inches;
P_n = normal diametral pitch = 20;
B = helix angle = 12 degrees 22 minutes;
l = lead of worm = 0.9643 inch;
P = linear pitch = 0.1607 inch;
W = whole depth of tooth = 0.1078 inch, according to formula $W = 2.157 \div P_n$, page 711 of the sixth edition of MACHINERY'S HANDBOOK;
b = root diameter of worm = $O - 2W$ = 1.2844 inches;
T = width of thread tool at end = $0.31 \times P$ = 0.31×0.1607 = 0.0498 inch

Specifications for Spiral Gear

N = number of teeth in gear = $n \times$ the ratio = 6×20 = 120 teeth;
D_1 = actual pitch diameter of spiral gear = $N \div P_n \cos B = 120 \div 20 \times 0.97680 = 6.1425$ inches;
$O = D_1 + 2 \times$ addendum = $6.1425 + 0.100$ = 6.2425 inches;
C = exact center distance = $(D_1 + d) \div 2$ = 3.77125 inches.

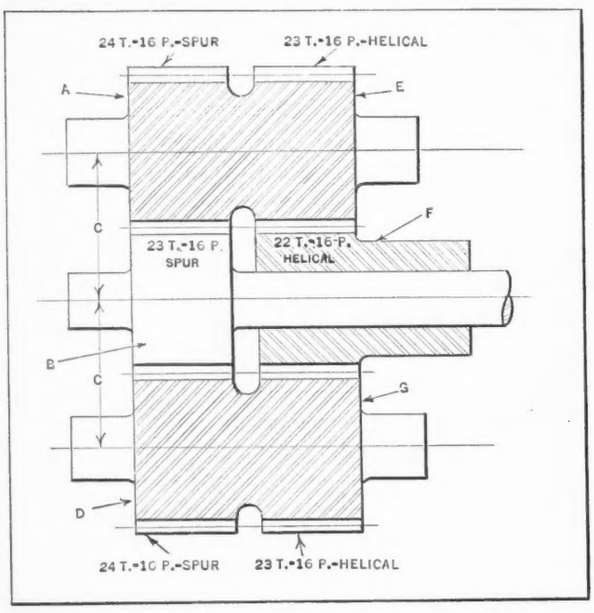
* * *

USING SPUR AND HELICAL GEARS IN PLANETARY TRANSMISSION

By W. L. ROMICK

In designing planetary transmissions, it is often found desirable to mount two pairs of gears of different ratios on shafts or collars having common centers or the same center distance. This can be done under certain conditions by using spur gears for one pair, and helical gears for the other pair.

It will be noted that the center distance C is the same for the spur gears A, B, and D as it is for the helical gears E, F, and G, but the ratios vary. The helix angle of the teeth of the helical gears can be calculated by the formula given in MACHINERY'S HANDBOOK, page 717, sixth edition.



Arrangement of Spur and Helical Gears in Planetary Transmission

PRESS WORK ON NICKEL SILVER

Nickel silver is used extensively for small pieces of apparatus and ornaments in which appearance and freedom from corrosion are of first importance. By far the greater portion of the nickel silver output, however, is used by electrical manufacturers, especially for low-voltage work such as is required in telephone, telegraph, and recording instrument construction. Most of the nickel silver components are of small size, and for this reason, press tools play an important part in their production. The sheet nickel silver commonly adopted for drawing and forming operations is composed of from 55 to 60 per cent copper, 12 to 15 per cent nickel, and the remainder, zinc.

In some cases, an alloy having a higher nickel content which increases the tenacity and at the same time greatly increases resistance to corrosion is required. Between 15 and 20 per cent nickel is common for such alloys. Although the press tools do not differ from those used on other common metals, considerable difficulty is experienced in determining the exact hardness of the nickel silver for a specific purpose.

Hardness of Nickel Silver for Press Work

As nickel silver possesses, to a great extent, the property of work hardening, this factor must be considered in specifying material. If the finished article is to have a Brinell hardness of 200, the material, before forming, must be somewhat softer, so that it will have the required hardness after the press operation. Nickel silver is very tenacious and drags at the punches. Nickel seems to have a detrimental effect on the cutting properties of a metal, and this must be considered when selecting a material for blanking, as good work cannot be produced at a reasonable press speed without a heavy repair bill for the press tools if the metal is below a certain hardness.

For the majority of work, nickel silver sheet material should not be passed to the press shops when it has a hardness below 90 Brinell or 12 scleroscope. For very deep drawing operations, softer alloys must sometimes be employed. This is possible because a shearing operation always follows the final draw. In such cases, the loss from waste material is more than counterbalanced by the elimination of annealing between drawing operations.

Nickel silver resists repeated stress very well, so long as it has been previously subjected to cold-working, and the stresses are well within the elastic limit or the yield point. Unfortunately, this property, although excellent in the finished product, is the cause of much trouble in the shop. For example, a spring is required to effect certain movements and at the same time to resist atmospheric corrosion. Nickel silver is chosen as the material, and the grade required is commonly known as "hard," which has a hardness of approximately 170 to 200 Brinell or from 33 to 44 scleroscope.

The problem is to bend a strip of metal without affecting its hardness. If the forming is too severe, the material will crack or laminate or fail in fatigue during its working life, both of which alternatives are equally objectionable. An over-worked nickel

silver alloy fails rapidly under repeated stress, and the line of demarkation between the fully-worked and the over-worked specimen is regrettably small. While annealing operations may be employed to reduce the hardness of non-ferrous springs, no practical method has been devised for hardening.

Avoiding Over-working of Nickel Silver

The methods of avoiding over-working nickel silver in use at present are variations of local annealing. The lead or salt bath finds some application, where the method is to immerse the part to be formed for an instant and then cool it in water. It has been found that a temperature of 90 degrees F. gives results superior to those where the usual 60-degree temperature is employed. Another method is to set the springs in a tray of water which covers the portion not to be formed, and allow the flame from a blow-torch to play over the exposed parts, which are later to be subjected to bending operations. A modification of this method is to employ a blast of air for cooling, but this is not so reliable, since conduction often takes place so rapidly that more temper is "drawn" than is actually required.

There are two other methods that may possibly be developed for treating nickel silver. One is to bombard the formed nickel silver pieces with balls. The effect of such treatment is to raise the hardness of the parts without producing appreciable deformation. This method has, it is believed, been used for the hardening of gear teeth. The other method employed for the final hardening of non-ferrous springs consists of subjecting the part to continued high-frequency vibrations.

Rules for Forming and Drawing Nickel Silver

In order to obtain reasonable success in forming and drawing nickel silver, all metal must be carefully graded and inspected. The press tool design, although not essentially different from that ordinarily used for other methods, must be carefully done, taking into consideration the action of "cold-working" on the material. Four grades of material are ordinarily referred to by dealers in nickel silver. The grade known as "soft" has a maximum Brinell hardness of 110; that known as "H hard," 135 to 195 Brinell; "hard," 170 to 200 Brinell; and "spring," a minimum of 195 Brinell.

It is often stated that since all hardness tests leave much to be desired, no strict reliance should be placed upon figures, and inspection should be tempered by the experience of the man through whose hands the metal passes, but this does not hold true when applied to nickel silver. While rigid adherence to the hardness ratings given in the foregoing may cause some deliveries to be rejected which might have given good service in the shops, it will practically eliminate any material which will cause undue trouble.

Press Tool Design

In order to produce a nickel silver part of the required hardness, it is sometimes necessary to work portions of the part that do not actually require forming or bending. This is done in some cases by using a thicker material than would otherwise be required, and subjecting the flat parts to a flowing operation at the same stroke that does the forming or bending. An advantage of this method is that the part is bulged slightly at the sides, thus removing the sharp edges. This action increases the resistance to corrosion which generally starts at the extremities of the part. Also the bulge occurs at the neutral axis of the section where the shear stress is at the maximum and where "laminating" is most likely to take place.

Often an extra bend not actually required as far as the shape of the piece is concerned is made in the part when the essential bends are made. The principle of "metal flow" should be utilized when designing tools for use on nickel silver. This means that the part should be subjected to an intense pressure far in excess of that required for the actual forming or drawing. In cases where this may be applied, extremely difficult operations may be carried out on the hardest material without the slightest sign of fracture or weakening of the metal, simply because the metal flows and is not distorted in the true sense. In other words, the metal behaves more like a liquid than a solid.

In choosing the material, it should be sufficiently soft to permit the most difficult forming operation to be performed. The additional hardening of the part produced by the press operations should bring all sections to the required degree of hardness.

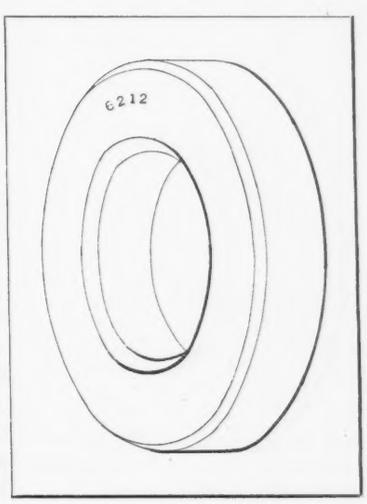
* * *

ASSEMBLING BALL-BEARING EQUIPPED MACHINERY

By J. S. BEGGS

In the building of special machinery, it is generally necessary to locate gears, pulleys, and other parts in assembling, thus necessitating the drilling of holes, filing, tapping, etc. In spite of the greatest care under these conditions, chips may get into the ball bearings used, and when this has happened it is very difficult to remove them from the bearings. To overcome this trouble, a dummy bearing, as shown in the accompanying illustration, may be used during assembling. After the machine has been cleaned up and ready to run, the real bearings may then be assembled in the machine.

The dummy bearings should be made from steel, hardened, and ground to the same size as the ball bearings. The bore of the dummy bearing, however, should be a push fit where the ball bearing would be a tapping fit. This will allow the shaft to be rotated by hand. These dummies may be made as required, with the bearing number stamped on the side, and kept with the tool-room equipment.



Dummy Ball Bearing Used in Assembling Ball-bearing Machinery

ANOTHER INSTANCE OF THE WORLD GROWING SMALLER

In a recent number of MACHINERY, we mentioned how an American machine tool builder received an order for twelve machines by telephone from Sweden. Another interesting example of the use of international telephone service was furnished in connection with the annual conference of the officials and sales force of the Fellows Gear Shaper Co., Springfield, Vt. It was not possible for the Paris representative of the company, C. P. Welte, to be present at the conference, but arrangements had been made for a telephone conversation with Mr. Welte at the time of the annual banquet, when E. R. Fellows, president and general manager of the company, and over thirty of the official and sales representatives, exchanged greetings with Mr. Welte over the 'phone. The conversation lasted for thirteen minutes, which is the longest transatlantic telephone conversation that has taken place from any point in the state of Vermont. The event was a pleasant surprise to many of the members of the company and made a great impression on those present.

* * *

STRADDLE-MILLING REVOLVING WORK

Two flanges, 24 3/4 inches over-all in diameter, are milled simultaneously on large pedestal cases by employing a standard Cincinnati vertical milling machine, equipped, as shown in Fig. 1, with a standard power-feed circular milling attachment. The pedestal case is held in a special universal fixture mounted on the attachment.

Fig. 2 shows an outline of the work and gives important dimensions. Four surfaces (as indicated by the heavy black lines) are milled accurately at one time. When the work is placed in the universal fixture, the rim of the circular portion rests on four fixed supports, while the casting is located centrally in the fixture by means of two fixed stops and two adjustable stops. A stop acting against the outer part of the casting serves as a driver.

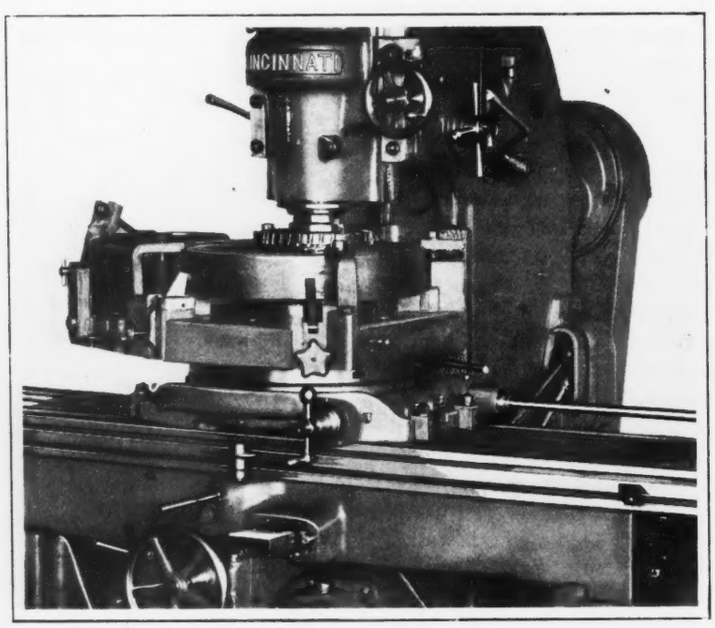


Fig. 1. Rotary Straddle Milling Operation on Pedestal Cases

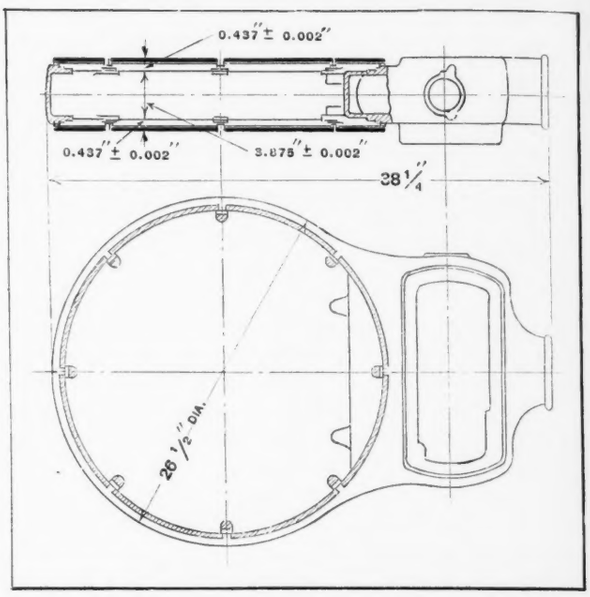


Fig. 2. Pedestal Case Milled in the Machine Illustrated in Fig. 1

Three strap clamps, which act directly over the fixed supports, hold the work in position.

Two large side milling cutters, mounted on a special stub arbor, finish the two flanges simultaneously. These cutters are set for milling by adjusting the vertical head to bring the cutters inside the casting. Then the power circular feed is engaged to rotate the work past the cutters, which finish the part at one revolution.

At the completion of the cuts, the cutters are cleared from the work by using the rapid table traverse, and then the head is raised to the starting position. The advantage of the adjustable head on a vertical machine of this size is immediately apparent when it is desired to adapt a standard machine to perform an operation of this kind.

* * *

According to the *Compressed Air Magazine*, the Michigan Metal Products Co. has devised a system of pneumatic door control known as the "Air-Dor" control, which can be used in connection with any standard type of straight swinging door, single or double sliding doors, or folding doors. With this device, it is possible to open and close factory or garage doors from a distance without alighting from the vehicle in which the person opening or closing the doors is riding. This system is especially advantageous around large factories, as it enables drivers of industrial trucks to open and close factory doors without moving from their places on the trucks. It is stated that one automobile plant that has five doors pneumatically operated in this manner has found that the installation for one of these doors paid for itself in six weeks of service, because of the time saved by the operator. In a period of fourteen weeks, this particular door was opened and closed over 14,000 times. In the winter, particularly, such a door-operating device is valuable.

RATIO TABLE FOR GEARS AND PULLEYS—1

Ratios for Pulleys from 5 to 17 Inches in Diameter

5	6	7	8	9	10	11	12	13	14	15	16	17	
1.25	1.5	1.75	2.5	2.75	2.0	2.25	3.0	3.25	3.5	3.75	4.0	4.25	4
	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	5
		1.167	1.333	1.5	1.667	1.833	2.0	2.166	2.333	2.5	2.667	2.833	6
			1.143	1.286	1.429	1.571	1.714	1.857	2.0	2.143	2.286	2.429	7
				1.125	1.25	1.375	1.5	1.625	1.75	1.875	2.0	2.125	8
					1.111	1.222	1.333	1.444	1.555	1.666	1.777	1.888	9
						1.1	1.2	1.3	1.4	1.5	1.6	1.7	10
							1.091	1.182	1.273	1.364	1.455	1.546	11
								1.083	1.167	1.25	1.333	1.416	12
									1.077	1.154	1.231	1.308	13
										1.071	1.143	1.214	14
											1.067	1.133	15
												1.063	16

Note—
When finding speeds or sizes of gears and sprockets, it is more convenient to use the number of teeth than to use the pitch diameters.

Ratios for Pulleys 18 to 30 Inches in Diameter Running With Pulleys 4 to 29 Inches in Diameter

18	19	20	21	22	23	24	25	26	27	28	29	30	
4.5	4.75	5.0	5.25	5.5	5.75	6.0	6.25	6.5	6.75	7.0	7.25	7.5	4
3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8	6.0	5
3.0	3.166	3.333	3.5	3.667	3.833	4.0	4.166	4.333	4.5	4.667	4.833	5.0	6
2.571	2.714	2.857	3.0	3.143	3.286	3.429	3.571	3.714	3.857	4.0	4.143	4.286	7
2.25	2.375	2.5	2.625	2.75	2.875	3.0	3.125	3.25	3.375	3.5	3.625	3.75	8
2.0	2.111	2.222	2.333	2.444	2.555	2.666	2.777	2.888	3.0	3.111	3.222	3.333	9
1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	10
1.636	1.727	1.818	1.909	2.0	2.091	2.182	2.273	2.364	2.455	2.546	2.636	2.727	11
1.5	1.583	1.667	1.75	1.833	1.916	2.0	2.083	2.167	2.25	2.333	2.416	2.5	12
1.385	1.461	1.538	1.615	1.692	1.769	1.846	1.923	2.0	2.077	2.154	2.231	2.308	13
1.286	1.357	1.429	1.5	1.571	1.643	1.714	1.786	1.857	1.929	2.0	2.071	2.143	14
1.2	1.267	1.333	1.4	1.467	1.533	1.6	1.667	1.733	1.8	1.867	1.9	2.0	15
1.125	1.188	1.25	1.313	1.375	1.438	1.5	1.563	1.625	1.688	1.75	1.813	1.875	16
1.059	1.117	1.176	1.233	1.292	1.35	1.408	1.471	1.529	1.588	1.647	1.706	1.765	17
	1.056	1.111	1.167	1.222	1.278	1.333	1.388	1.444	1.5	1.556	1.611	1.667	18
		1.053	1.105	1.158	1.21	1.263	1.316	1.368	1.421	1.474	1.526	1.579	19
			1.05	1.1	1.15	1.2	1.25	1.3	1.35	1.4	1.45	1.5	20
				1.048	1.095	1.143	1.19	1.238	1.286	1.333	1.381	1.429	21
					1.045	1.09	1.136	1.182	1.227	1.273	1.318	1.364	22
						1.043	1.087	1.13	1.174	1.217	1.261	1.304	23
							1.042	1.083	1.125	1.167	1.208	1.25	24
								1.04	1.08	1.12	1.16	1.2	25
									1.038	1.077	1.115	1.154	26
										1.037	1.047	1.111	27
											1.036	1.071	28
												1.034	29

Example—What are the diameters of a pair of medium size pulleys for shafts which are to run at 300 and 862 revolutions per minute?

The speed ratio = 862 ÷ 300 = 1.207. Now the ratio given in the table at the intersection of the vertical column under 12, and the horizontal line opposite 10 in the column at the right-hand side of the table is 1.2, which is nearly the required ratio and indicates that pulleys 12 and 10 inches in diameter, respectively, may be used.

Example—What is the speed of a 17-inch pulley driven by a 23-inch pulley running at 227 revolutions per minute?

At the intersection of the vertical column under 23 and the horizontal line opposite 17 we find the ratio 1.35. Now 1.35 × 227 = 306 R.P.M.

Example—What is the speed of a 23-inch pulley driven by a 17-inch pulley running at 227 revolutions per minute?

The ratio for 23 and 17, according to the table, is 1.35, and 227 ÷ 1.35 = 168 revolutions per minute, approximately.

Copyright, 1929, The Industrial Press

MACHINERY'S Data Sheet No. 147, New Series, February, 1929

Contributed By O. L. Stevens

RATIO TABLE FOR GEARS AND PULLEYS—2

Ratios for Pulleys 31 to 43 Inches in Diameter Running with Pulleys 4 to 42 Inches in Diameter

31	32	33	34	35	36	37	38	39	40	41	42	43	
7.75	8.0	8.25	8.5	8.75	9.0	9.25	9.5	9.75	10.0	10.25	10.5	10.75	4
6.2	6.4	6.6	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.6	5
5.167	5.333	5.5	5.667	5.833	6.0	6.167	6.333	6.5	6.667	6.833	7.0	7.167	6
4.429	4.571	4.714	4.857	5.0	5.143	5.286	5.429	5.571	5.714	5.857	6.0	6.143	7
3.875	4.0	4.125	4.25	4.375	4.5	4.625	4.75	4.875	5.0	5.125	5.25	5.375	8
3.444	3.555	3.666	3.777	3.888	4.0	4.111	4.222	4.333	4.444	4.555	4.666	4.777	9
3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	10
2.818	2.909	3.0	3.091	3.182	3.273	3.364	3.455	3.546	3.636	3.727	3.818	3.909	11
2.583	2.667	2.75	2.833	2.916	3.0	3.083	3.167	3.25	3.333	3.416	3.5	3.583	12
2.385	2.461	2.538	2.615	2.692	2.769	2.846	2.923	3.0	3.077	3.154	3.231	3.308	13
2.214	2.286	2.357	2.429	2.5	2.571	2.643	2.714	2.786	2.857	2.929	3.0	3.071	14
2.067	2.133	2.2	2.267	2.333	2.4	2.467	2.533	2.6	2.667	2.733	2.8	2.867	15
1.938	2.0	2.063	2.125	2.188	2.25	2.313	2.375	2.438	2.5	2.563	2.625	2.688	16
1.824	1.882	1.941	2.0	2.059	2.118	2.175	2.233	2.292	2.35	2.408	2.471	2.529	17
1.722	1.778	1.833	1.889	1.944	2.0	2.056	2.111	2.167	2.222	2.278	2.333	2.389	18
1.632	1.684	1.737	1.789	1.842	1.895	1.947	2.0	2.053	2.105	2.158	2.211	2.263	19
1.55	1.6	1.65	1.7	1.75	1.8	1.85	1.9	1.95	2.0	2.05	2.1	2.15	20
1.476	1.524	1.572	1.619	1.667	1.715	1.762	1.81	1.857	1.905	1.953	2.0	2.048	21
1.409	1.455	1.5	1.545	1.591	1.636	1.682	1.727	1.773	1.818	1.863	1.909	1.954	22
1.348	1.391	1.435	1.478	1.522	1.565	1.609	1.652	1.696	1.739	1.783	1.826	1.869	23
1.292	1.333	1.375	1.417	1.458	1.5	1.542	1.583	1.625	1.667	1.708	1.75	1.792	24
1.24	1.28	1.32	1.36	1.4	1.44	1.48	1.52	1.56	1.6	1.64	1.68	1.72	25
1.192	1.231	1.269	1.308	1.342	1.385	1.424	1.462	1.5	1.538	1.577	1.615	1.654	26
1.149	1.185	1.222	1.259	1.293	1.333	1.367	1.407	1.444	1.481	1.515	1.556	1.592	27
1.107	1.143	1.179	1.214	1.25	1.285	1.321	1.357	1.386	1.428	1.464	1.5	1.536	28
1.069	1.103	1.138	1.172	1.207	1.241	1.276	1.31	1.345	1.379	1.414	1.448	1.483	29
1.033	1.067	1.1	1.133	1.166	1.2	1.233	1.267	1.3	1.333	1.367	1.4	1.433	30
	1.032	1.065	1.097	1.129	1.161	1.194	1.226	1.258	1.29	1.323	1.355	1.387	31
		1.031	1.062	1.094	1.125	1.156	1.187	1.219	1.244	1.281	1.312	1.344	32
			1.03	1.061	1.09	1.121	1.151	1.182	1.212	1.242	1.273	1.303	33
				1.029	1.059	1.085	1.118	1.147	1.176	1.206	1.235	1.265	34
					1.029	1.057	1.085	1.114	1.143	1.71	1.2	1.229	35
						1.028	1.056	1.083	1.111	1.139	1.167	1.194	36
							1.027	1.054	1.081	1.108	1.135	1.168	37
								1.026	1.053	1.079	1.106	1.132	38
									1.026	1.051	1.077	1.103	39
										1.025	1.05	1.075	40
											1.034	1.048	41
												1.024	42

Example—How many teeth should there be in each gear of a pair of gears in mesh on shafts which are to run at 300 and 362 revolutions per minute, respectively?

The speed ratio = 362 ÷ 300 = 1.207. Now the ratio given in the table at the intersection of the vertical column under 40, and the horizontal line opposite 33 in the column at the right-hand side of the table is 1.212, which is nearly the required ratio and indicates that gears having 40 and 33 teeth, respectively, will give approximately the required speed.

Example—What is the speed of a 33-tooth gear driven by a 40-tooth gear running at 227 revolutions per minute?

At the intersection of the vertical column under 40 and the horizontal line opposite 33 we find the ratio to be 1.212. Now 1.212 × 227 = 275 revolutions per minute, approximately.

Example—What is the speed of a 40-tooth gear driven by a 33-tooth gear running at 227 revolutions per minute?

The ratio for 40 and 33, according to the table, is 1.212 and 227 ÷ 1.212 = 187 revolutions per minute, approximately.

Note: When finding speeds or sizes of gears, it is more convenient to use the number of teeth than the pitch diameter. In the case of belt drives, the diameters of the pulleys are, of course, used.

Copyright, 1929, The Industrial Press

MACHINERY'S Data Sheet No. 148, New Series, February, 1929

Contributed By O. L. Stevens

"Carboloy" and Tungsten Carbide Tools*

A Review of the Properties and Uses of "Carboloy"—the New Cutting Metal which Promises to Bring About Many Changes in Present-day Shop Practice

By SAMUEL L. HOYT, Research Laboratory, General Electric Co.

A GREAT deal of interest is being shown in the new tool material which has tungsten carbide as a base and for which the General Electric Co. has adopted the trade name "Carboloy." In a paper read before the annual meeting of the American Society for Steel Treating in Philadelphia in October, 1928 (of which an abstract was published in November MACHINERY, page 214), the general properties of this new material were outlined. Additional information was given in a paper presented before the Production Meeting of the Society of Automotive Engineers, held in Detroit in November. (This paper was published in January, 1929, MACHINERY, page 353.) The present article will deal with such features as are of particular interest to mechanical engineers and shop executives.

Tungsten carbide may be classed as one of the hardest of materials, coming just below the diamond. In addition, it has a metallic, rather than a non-metallic, structure. To this it undoubtedly owes its present position as a tool material, for it unites with cobalt and similar metals to produce a combination of strength, hardness, and toughness which is unique among materials of its class. With a strength over half that of high-speed steel, its Brinell hardness number runs to over 2000, and it is capable of scratching a sapphire. In addition, it loses none of this hardness, as steel does, by having its "temper drawn" when heated, but retains its metal-cutting hardness at a bright red heat. This material, therefore, seems to be destined to find many applications in the mechanical arts. The art of utilizing tungsten carbide however, is still in its infancy; time and experience alone can teach us how it is to be handled and how to delimit accurately the scope of its applications.

In machining bakelite, remarkable results have been obtained through the use of "Carboloy." In the past, with the best available tools, machining bakelite blanks at a surface speed of 600 feet per minute, the tools had to be removed and reground about every 150 blanks. At the start of each run a few blanks would be lost, until the tools were properly set up. At the end of the run, a few more would be lost because of unsatisfactory finish or incorrect size. When "Carboloy" tools were substituted, with the same operating conditions and inspection, 11,000 blanks were finished before the tools required regrinding. This is a ratio of about 70 to 1 in favor of "Carboloy," and indicates the great possibilities of this new cutting metal in certain instances.

Methods of Preparing "Carboloy" Tools

At present "Carboloy" is made in relatively small pieces, ranging from 1/4 to 3/4 inch square, with a length up to several inches. It is also made in disk form, in sizes up to 1 1/4 inches in diameter and 1/2 inch thick, and as thin blades, drills, etc., for experimental purposes. It is made up in tools either as a tool bit held in a tool-holder or as a tip, brazed on a steel shank, to form the cutting edge. Sometimes a bit is brazed on a shank and used in a tool-holder. In this way, it is possible to make tools that are large enough to perform most machining operations. Tools of special shapes can be made up for handling special cuts in production work.

Those who have had similar experience with the brazing of high-speed steel tips, will be skeptical as to the utility of a tool made in this manner. Experience has shown that the failure at such joints is largely due to heavy pressures and high temperatures, particularly to the former. When it is borne in mind that the natural strength of tungsten carbide limits the permissible cutting to pressure well below that used with brazed high-speed steel tools, it will be clear that difficulties from this source are not so serious as they are with high-speed steel. In other words, it is probably much easier to make a brazed joint with tungsten carbide, which is as strong as the carbide itself. Tungsten carbide itself will probably never be able to handle heavy hogging cuts on steel, so that the ability of the brazed joint to withstand that service may never need to be tested.

Brazing "Carboloy" to Steel

The brazing is done by the method of "copper brazing," which has been studied in great detail in the past at the General Electric Research Laboratory. This experience has been available for the work on "Carboloy" tools, and has contributed greatly to the success in that field. The equipment and materials used, and the care and skill with which the operations are performed, have probably been largely responsible for the results. The materials of the tool bits and of the shanks offer no particular difficulties, and to date many different tool materials have been brazed to shanks of cold-rolled steel, machine steel, high-carbon or tool steel, nickel steel, high-speed steel, and a few special compositions. It has also been found that the bits can be silver-soldered to the shank with an ordinary gas burner and flux, but here it seems that a rather careful control of the temperature is required to make the flux and solder flow properly. The more usual methods of brazing can be employed for "Carboloy" if a shop is not equipped to do copper

*Abstract of a paper presented before the Machine Shop Practice Division of the American Society of Mechanical Engineers at the annual meeting in New York City, December 3 to 7, 1928.

brazing, but the author's experience is largely confined to the latter. Other methods of joining the bit to the shank are being studied at present in the Research Laboratory.

Materials Used for Tool Shanks

The shank itself is now generally made of medium carbon nickel steel. In some respects high-speed steel is superior to nickel steel, for it can pass through the hydrogen brazing furnace without coarsening. The carbon steels come out with a very large grain structure and are comparatively weak as a consequence; but it has been found in practice that high-speed steel shanks are likely to split open, or at least to check badly. Nickel steel shanks come through the brazing treatment in good condition for use in the shop, and in the process about to be described, nickel steel has been found to have a decided advantage over high speed steel for the shanks of "Carboloy" tools.

Preparing the Shank for Brazing

The shanks are first ground to shape to give the desired cutting angles and shape for the finished tool. With nickel steel this operation can be rapidly and economically done. A slot is then milled out of the nose of the tool, into which the tool bit proper is copper-brazed. Some judgment is required in laying out this work, for it is desirable to reduce the amount of grinding to a minimum, and to secure as good a fit as possible between bit and shank.

Other methods of uniting bit and shank have been tried, but it has been found that a rigid joint, such as would be secured by welding, is only too likely to split at the joint or in the immediate vicinity. This failure may occur shortly after the weld is made or after the tool has been put in service. In other words, it is better to have a soft cushion between the bit and shank which can take up small stresses that may be caused by the different coefficients of expansion of the tungsten carbide and steel. On the other hand, it has also been observed that too much brazing metal is bad. The pressures and temperatures involved are likely to force the metal out of the joint and rob the bit of its support directly beneath the point. This action leads to breakage of the tool. By controlling the copper brazing and the design of the tool, it has been found possible to reduce this hazard to an unimportant factor, while still retaining the valuable cushioning properties of the copper joint.

The tool sizes and shapes are not greatly different from those used with high-speed steel, although it has been found desirable to depart somewhat from the standard angles for some work. This particular point is being studied, for its importance is held to be very great, but the field is so large that there is small hope of properly covering it in the near future.

It is not claimed that "Carboloy" tools are suitable for all kinds of metal cutting. They are of especial value when the cuts taken are comparatively fine and the machining speed comparatively high. On the other hand, they are not recommended for heavy hogging cuts, running, perhaps, an inch deep with a 1/8-inch feed. These cuts now appear to be outside of the range of "Carboloy" tools. However, when the conditions are such that a light feed must be used in order to obtain a good finish, then the "Carboloy" tools are placed in their most favorable position, for in taking such cuts they have a longer life than any steel tools so far known, and are capable of running at twice the speed.

Grinding of "Carboloy" Tools

The question of grinding "Carboloy" may occur to some as being rather serious. From what has been said, it is obvious that the softer wheels are not suitable. The only commercial material that is hard enough, and available in wheel form, is silicon carbide. A coarse grade is employed for roughing, with very much the same technique that is used with high-speed steel, except that no water cooling is permitted. Light pressures must also be used to avoid setting up excessive stresses in the metal. A fine wheel puts a sufficiently keen edge on the tool for most machine operations.

Surface grinders are used to prepare tools of special shape, in case the dimensions are to be held within close limits. However, "Carboloy" is so hard that the wheel wears away much more rapidly than is customary with ordinary tool materials, and this circumstance introduces a new factor, if the tolerances are small. With the wheel wearing away continuously, a single cut cannot produce a plane surface, so that special methods must be employed to shape this material with close tolerances. With the methods of lapping, and particularly of diamond lapping, it is possible to work with "Carboloy" to 0.0005 inch or even closer.

How to Lap "Carboloy" Tools

Lapping has generally been done with silicon carbide powder, either by hand or with a machine, but this method is not so rapid as is desirable and generally leaves the surface too rough. Tungsten carbide powder has also been used for finishing, to get a smoother surface, but tungsten carbide is expensive for this purpose and is not very rapid in the size which is readily available. Recently it has been found that boron carbide combines rapid lapping with a smooth finish, and this material looks very promising. Curves showing the rate at which different lapping powders remove metal from a surface of "Carboloy," and the rate at which the powders lose their cutting action, have shown that boron carbide cuts quite as fast at the start as silicon carbide, or even faster, and retains its cutting ability about twice as long. By combining powder of different sizes, it has been possible to secure a boron carbide lap which cuts rapidly at the start and retains its cutting ability for a comparatively long time. Another advantage of boron carbide is that it leaves the surface relatively smooth, with a velvety appearance. Incidentally, this type of finish has been found of great value for certain finishing cuts where a keen-edged tool is required.

The most satisfactory material for lapping tungsten carbide is diamond powder, its only drawback being its high cost. A copper lapping disk charged with a medium coarse dust cuts tungsten carbide very rapidly and gives a true surface, except for

the grooves cut by the particles of diamond. Such a surface can then be polished on a copper or wood lap using finer powder. A No. 6 grade of diamond dust held on a wood lap with almond oil will give a highly polished surface, sufficiently good for high-power microscopic examinations. This powder is so fine that it can be said that no metal is actually removed by the process.

Ordinary machine shop grinding practice requires simply the two grades of wheels. An operator can be readily trained to grind the tools properly, and no particular difficulties may be expected from this source.

The Application of "Carboloy" in Machine Shop Operations

Sufficient information has already been given concerning the properties and behavior of tungsten carbide to enable us to predict, on that basis alone, the most promising field for its use, namely, that of machining materials which are so abrasive that ordinary tools are speedily worn away and lose their cutting edge but which do not exert great pressures on the tool. The performance on hard carbon, "Genelite," commutators, "Mycalex," bakelite, hard rubber, etc., has been briefly reviewed, in the articles previously referred to, and it has been pointed out that the tool life is materially increased, due to the greater resistance to abrasion possessed by tungsten carbide.

In one case bakelite blanks were being machined (faced) with steel tools. The speed was about 600 feet per minute, which was as fast as the machine could run. At this speed the tools had to be removed and reground about every 150 blanks. At the end of each run, a few blanks would be lost in inspection on account of finish, dimensions, etc. At the start of each run a few more would be lost in getting the tools properly set up. Furthermore, the finish required on the parts necessitated that the tool be a certain definite shape, and this was not always possible. At different times a few parts would be lost at the beginning of the run because of this, and more time would be lost, and on these occasions the tools would have to be reground and reset. This job was equipped with "Carboloy" tools of the same shape as the standard tools, and, with the same operating conditions and inspection, 11,000 blanks were finished before the tools required regrinding. This gives a ratio of about 70 to 1 in performance.

Tests on the machining of fiber have brought out another advantage of using tungsten carbide tools as compared with those of high-speed steel. The speed corresponding to the economical tool life of high-speed steel on fiber lay well below the speed at which the best surface finish was secured. This situation was completely altered by using "Carboloy" tools on such jobs, for the increased speed resulted in a material improvement in both production and finish.

Comparison between "Carboloy" and Diamond Tools

Diamond tools are very useful in performing certain cutting operations where tool abrasion and surface finish are vital factors in the production of the parts being machined. Diamond tools have their field, and it is not likely that either "Carboloy" or other tools will replace them, but "Carboloy" tools have such unusual hardness that their applications in this general field seem worth while investigating.

Diamond tools are generally of small size and of some simple shape. It is not an easy matter to give diamond tools shapes such as are found in steel tools. "Carboloy" tools, on the other hand, are made up in a wide range of sizes and shapes, without undue cost. Outside of very light cuts, the use of diamond tools is very limited in metal cutting, while "Carboloy" tools are exceptional in their ability to cut metal. Diamond tools are always expensive, on account of both material and labor, and tool breakage places a rather serious burden on the cost of the machining operation.

In repairing broken tools, in sharpening new tools, and in regrinding worn tools, it has been found that the "Carboloy" tools possess another advantage over the diamond. The diamond is itself the hardest known material. This means that there is nothing harder available with which to grind and lap the diamond tool, and hence it follows that shaping operations using diamond dust must necessarily be relatively expensive. "Carboloy" tools, as has been shown, can be easily and economically shaped and ground. Furthermore, the "Carboloy" tools can be handled with standard equipment, such as grinding wheels, grinders, etc., which are not available for work with the diamond.

The experiments made at the Schenectady Plant of the General Electric Co. have brought out that unless machine tools permit of much higher speeds than those now generally provided, "Carboloy" tools cannot be used to their best advantage. At ordinary speeds these tools are unusually durable, but they do not increase production commensurate with their inherent cutting efficiency. It is likely, therefore, that machines intended for machining operations for which "Carboloy" tools are suitable will have to be redesigned to provide the required speeds. On the other hand, there is no evidence that greater strength will be required than is available in existing machine tools, as the cuts made by "Carboloy" will be comparatively light.

"Carboloy" Tools for Machining Metals

It has been shown that "Carboloy" tools are capable of machining metals that dull the ordinary tools almost at once, and of operating at speeds for an hour or more on such metal as nickel steel at a speed at which high-speed steel is ruined almost immediately. A "Carboloy" tool can operate at twice the speed of a high-speed steel tool on a given cut, for a length of time which breaks down the edge of the high-speed tool when operating at the lower speed, without showing any appreciable wear. Such performances may be termed spectacular, and they indicate the possibilities that await the use of the new material.

But the new material also has its limitations, and its relatively low physical strength confines its application to work which, for one reason or another, does not stress the tool bit above the breaking load.

These limitations are felt particularly keenly in the steel or metal field where tool pressures are so high.

Heavy "hogging" cuts, running 1 inch deep with a 1/8-inch feed seem now to be outside the range of "Carboloy" tools. Here the size of the work is large, the speeds are necessarily slow because such large masses of metal cannot be moved very rapidly, and the necessity for speeding up the removal of metal requires the use of heavy feeds. Furthermore, the tool size must be kept within reason, and therefore the tool pressure, and the unit tool pressure, are inordinately high. These conditions seem to be very unfavorable to the use of "Carboloy" tools.

The Field for which "Carboloy" is Best Adapted

As the size of the parts decreases, the cuts taken decrease and the speed of machining increases. Here we begin to enter the field where the "Carboloy" tools are more likely to compete to advantage with steel tools, for tool pressure becomes of less importance and cutting efficiency of greater importance. The author would not attempt now to draw the line between the two fields, but he can at least indicate some of the points which seem of importance in handling cuts which involve pressures below the strength of the carbide tool material.

A special study conducted by A. C. Danekind of the Schenectady plant of the General Electric Co. has shown the great importance attaching to the shape of the tool and the angles to which the edge is ground. If we may assume that the tools are correctly ground, then the feed is the most important factor in machining a given steel, for we find that too great a feed causes the end of the nose to chip or break off. By reducing the feed slightly, the pressure is relieved considerably and the tool performance improved correspondingly. After a certain amount of this type of experience, it is obvious that the rapid removal of metal with "Carboloy" tools requires the use of lighter feeds and higher speeds than with high-speed steel. From this it follows that the position of high-speed steel becomes more favorable if the conditions do not restrict the feed which can be used, for high-speed steel removes metal faster by using heavy feeds and slow speeds than by light feeds and high speeds. The "Carboloy" tool, on the other hand, may be said to be limited to the lighter feeds due to its lower strength, and it is only in cases where high speeds can be used that the newer tools will be able to compete with present tools.

If the conditions are such that light feeds must be used, for finish or to avoid heating the work, etc., then "Carboloy" tools are placed in a more favorable position, for, in taking those cuts that do not overload the "Carboloy" tools, they have a greater life than those of high-speed steel at twice the speed. In this field it seems to be good practice with high-speed steel to take cuts whose cross-sections are of the order of 1 per cent of the tool cross-section. It will also probably be advisable to adhere to this chip-to-tool ratio, or even stay below it with the "Carboloy" tools. The actual values of the feeds which may be held in mind are from 1/32 to 1/64 inch.

It is obvious that these factors must vary with the iron or steel machined and with its physical condition. They vary so much that it would be beyond the scope of the present article to attempt to detail the best practice; it will require considerable time to secure all the necessary data.

Effect of "Carboloy" on Machine Tool Equipment

Experience at the Schenectady plant of the General Electric Co. has shown that machines which do not permit much higher speeds than those now used cannot use "Carboloy" to the best advantage. With present machines, the tool enters the class of durable tools, but does not speed up production commensurate with its inherent cutting efficiency. We may predict, therefore, that a study will be made of the new tool material and that machine tool equipment will be designed to translate the possibilities of "Carboloy" into performance. Operations that are now done at low speeds, or manually, will be done by machine and at much higher speeds. Operations that are now done in a way to conserve the tool or its cutting edge will be done with greater freedom from concern as to the ability of the tool to stand up. Operations that now permit fairly large tolerances and are to be followed by finishing operations, will be done in one operation to finished, or nearly finished, size. Some operations that are now done wet will be done dry, for it is not so necessary to keep the tool cool. New ways will be found to perform old operations, and new materials will be machined that are better adapted to certain engineering requirements than those now in general use. Time alone can divulge the steps of this development and the extent of the changes that will follow.

The Cost of "Carboloy" Tools

While it is not the author's intention to discuss the cost of "Carboloy," it may be well to mention that it is made from relatively expensive ingredients and by a process that is necessarily more expensive than the usual steel-making processes. It is also much denser than steel. It is evident that "Carboloy" must stand at a disadvantage on a weight basis, and still more so on a volume basis, as compared to high-speed steel. On a tool-for-tool basis, the two are brought more nearly to a parity, for only a relatively small portion of the whole tool is made of expensive material. The vital point, in the author's opinion, is the relative performance of the two materials. On this basis, the relative economic value of "Carboloy" as compared to high-speed steel will vary with the nature of the material machined and the operations performed, and it will be necessary to determine this factor for each new application. It is probably obvious, from what has been stated, that the economic value of "Carboloy" will be so great in many instances that its use will be justified at once. In other cases, this preponderance will not be so great, and some study will be required to determine the more economical tool material. In still other cases, "Carboloy" will be less economical than other tool materials or not suitable at all. Among the latter applications may be mentioned hogging cuts on steel, or, in general, cuts with heavy feeds and those that impose heavy pressures on the tool.

New Machinery and Shop Equipment

A Complete Monthly Record of New Metal-working Machinery, Tools, and Devices for Increasing Manufacturing Efficiency and Reducing Costs

THE "HARTOMETER"—A NEW THREAD GAGE

A limit or tolerance thread gage known as the "Hartometer," which embodies an entirely new principle in the gaging of screw threads, has been designed by James Hartness, president of the Jones & Lamson Machine Co., Springfield, Vt., and has been placed on the market by that company. The object of the gage is to determine quickly and definitely whether screws tested by it are within the right lead and pitch diameter tolerances prescribed for a given class of fit.

As shown in the accompanying illustrations, and particularly in the line engraving Fig. 2, the gage consists of two parts, *A* and *B*, threaded on the inside to receive the screw *C* to be gaged. Two cover plates *L* are provided, on which are marked the tolerance zones. Two pins *K* are used for moving the part *B* of the gage to the right or the left to bring the pointer *G* to the indicating positions opposite the tolerance zones. It will be seen that the outside of part *B* is threaded and engages threads in part *A*. This thread *d* is of a slightly different pitch from the pitch of the screw to be gaged, so that when part *B* is moved to the right or the left, by turning it by the pins *K*, a differential movement is introduced. In other words, part *B* of the gage moves a very slight amount relative to screw *C* as it is turned around—only sufficient to bring the contact of the threads in *B* from one side to the other, of a thread in *C*.

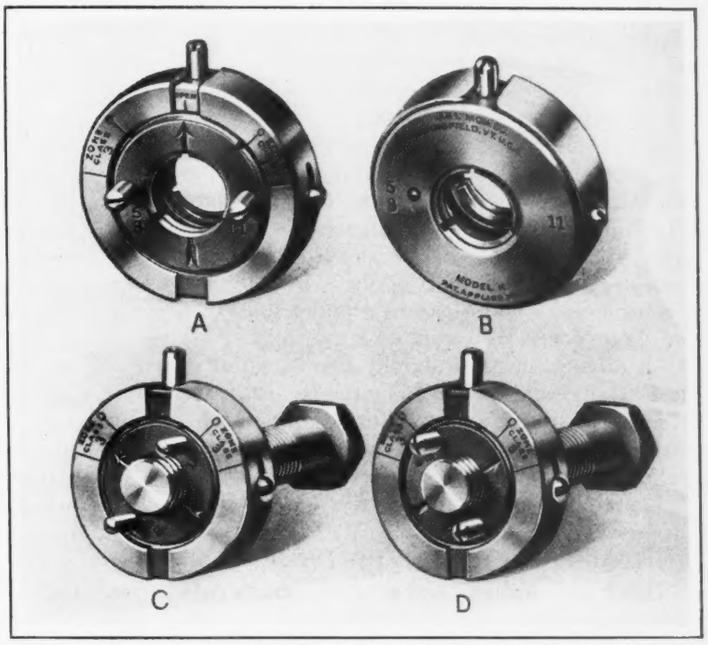


Fig. 1. The Hartometer Gage, Showing at A and B, Front and Rear Views, and at C and D, a Screw of Right Size being Gaged

With this general idea of the construction of the gage in mind, its application in practice can be more readily understood. When a thread is to be gaged, the pointer *G* is first moved until it coincides with the open position marked *H*. The screw to be tested is screwed into the gage while it is in this position. Then the pointer is simply moved first to one side and then to the other, and if it is stopped by the contact of the threads anywhere within the tolerance zones on both sides of the gage, the thread is within the prescribed tolerance. If, however, the pointer comes to rest outside of the tolerance zone, either on the right- or left-hand side of the open position, the screw is not within the prescribed limits and does not pass the test. One advantage of the gage, as compared with an ordinary limit gage, is that it shows definitely when the screws are nearly within the prescribed limits or when they just barely pass, but yet are close to the danger zone, because, according to the position of the pointer in relation to the tolerance zone, the relative amount of error is easily observed.

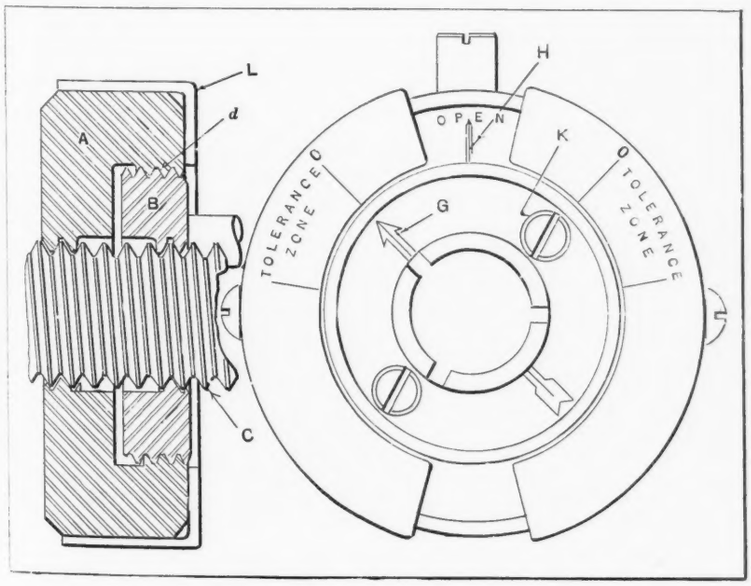


Fig. 2. Views Showing the General Design of the Hartometer

On a screw of correct lead, the travel to the right and the left, relative to the open position, will be equal. A screw on which the indicator has a greater travel to the right than to the left has a longer lead than standard. A screw on which the indicator has a

shorter travel to the right than to the left has a shorter lead than standard.

Before leaving the factory all Hartometer gages are properly adjusted to a master plug gage. This adjustment is made by screwing the master plug into the gage and turning the pointer both to the right and to the left in order to establish the point that is marked on the cover plates as zero, or the basic point from which the zone limits are established. Once properly set, the cover plates are sealed with wax. This seal need be broken only when, by occasional check up with the plug gage, adjustment is found necessary.

It will be seen that the operator of the gage is required to note only that the pointer stops within the tolerance zone, and hence, the gage eliminates any dependence upon the operator's skill or judgment. The threads, as indicated in the illustrations, are grooved to provide a lodging place for dirt or dust. These grooves make it easy to keep the gage perfectly clean.

An advantage that should also be emphasized is that it is possible with this gage to accurately compare three-fluted and five-fluted taps with a plug gage, something that in the past required rather elaborate measuring devices and calculations.

CHAMBERSBURG BOARD DROP-HAMMER

Silent operation is one of the principal features of a model H board drop-hammer recently developed by the Chambersburg Engineering Works, Chambersburg, Pa., it being stated that the crash of the blow is practically the only sound heard in the operation of the machine. The front rod operates between rollers, and both ends of its stroke are cushioned. Absence of friction permits the use of a sliding cam to actuate the front rod and thus obtain quiet operation. An improved pedal construction is a feature that facilitates operation. Greater roll adjustment than on previous machines, an improved clamp, and adjustable guides eliminate drag on both the ram and board, thus giving greater impact per blow and more blows per minute.

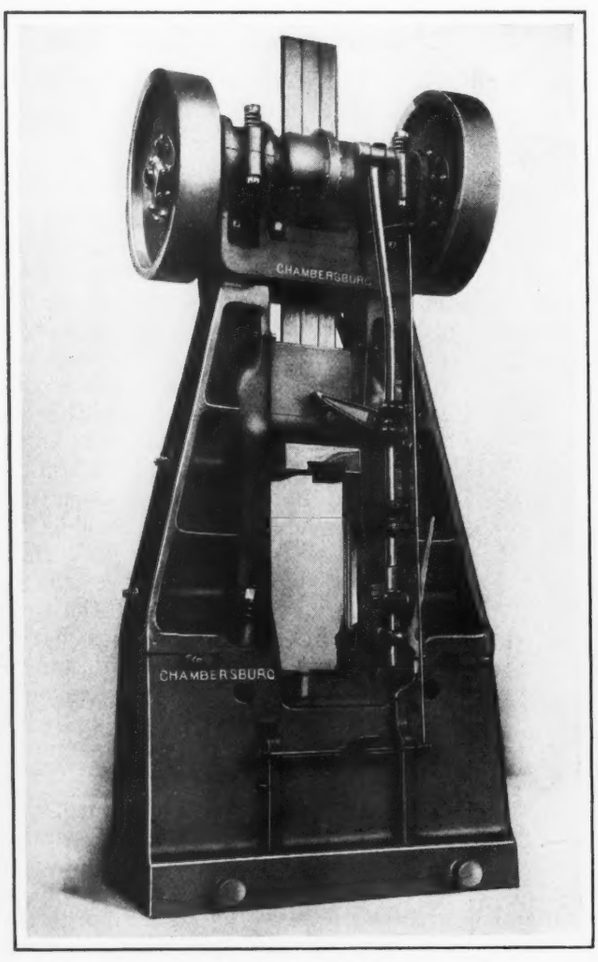


Fig. 1. Chambersburg Model H Board Drop-hammer

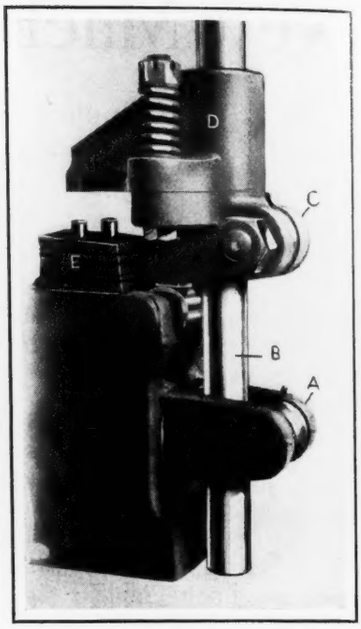


Fig. 2. Cushioning Feature for Front Rod

The two rollers between which the front rod operates are made of hardened steel. The lower roller on pull-back *A*, Fig. 2, bears on the rod, which is seen at *B*. A hardened tool-steel track inserted in clamp *C*, with its upper end butting against stop *D*, comes in contact with the upper roller, which is supported by the frame. In the top position, the track rests on this roller and is cushioned against the stop. The stop slides on the front rod, being attached to clamp *C* by means of spring balancing bolts. As the stop reaches the down position, it comes in contact with the non-metallic cushions shown at *E*. These cushions can be added to or reduced to suit the boards.

Accessibility of the front rod is another improved feature of the hammer. By removing the pull-back roller and pin and rolling the release lever from its bracket, the front rod is freed to swing outward for the renewal of any part. The patented stepped and tongued frame seats of the 20 to 1 steel anvil play a major part in the accuracy of forgings. The male tongues of this seat are on the anvil, so that when the latter gets hotter than the frames during operation, proper fits will be maintained by the expansion of the tongues. Wearing plates on the sides of the tongues can be renewed without disturbing any other part of the hammer. Precise die adjustment without sacrificing guide clearance is made possible by the provision of micrometer adjusting wedges.

The rolls of this hammer are mounted on large heat-treated alloy-steel shafts which are kept in parallel alignment by roller bearings. The Chambersburg patented interlocking eccentric makes this construction possible. Increased clearance between the rolls and the board, together with the full floating clamp, assures freedom of the board

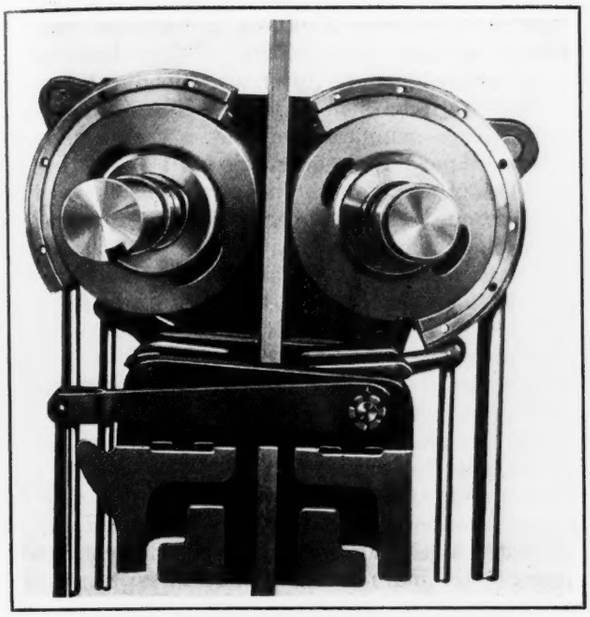


Fig. 3. Sectional View Showing Head Construction

on the down stroke. Greater throw in the eccentrics permits longer use of the boards. The rolls are ventilated, since cooler rolls operate with less friction. Oil for lubricating the roller bearings of the roll shafts and the eccentrics is stored in a reservoir formed in the head. Fig. 3 shows a sectional view through the center of the head.

Adjustable guides supported entirely by the frames provide for the accurate maintenance of proper ram clearance and alignment. These guides may be renewed without removing the ram, and likewise, the ram is removable over the tops of the guides. A patented interlocking tie-plate maintains frame alignment in all planes and protects the head. Accidental over-travel of the ram is prevented by the tie-plate.

SHIELDS PLAIN AND UNIVERSAL MILLING MACHINES

Milling machines in both plain and universal types are being introduced on the market by the Shields Machine Tool Co., 407 West St., New York City, in a range of sizes, the smallest of which weighs 3100 pounds, and the largest, 6800 pounds. The smallest machine is provided with a table measuring 11 by 40 inches, which has a longitudinal movement of 22 inches, a transverse movement of 8 inches, and a vertical movement of 18 inches. The largest machine has a 15- by 68-inch table, with a longitudinal movement of 42 inches, a transverse movement of 14 inches, and a vertical movement of 19 inches.

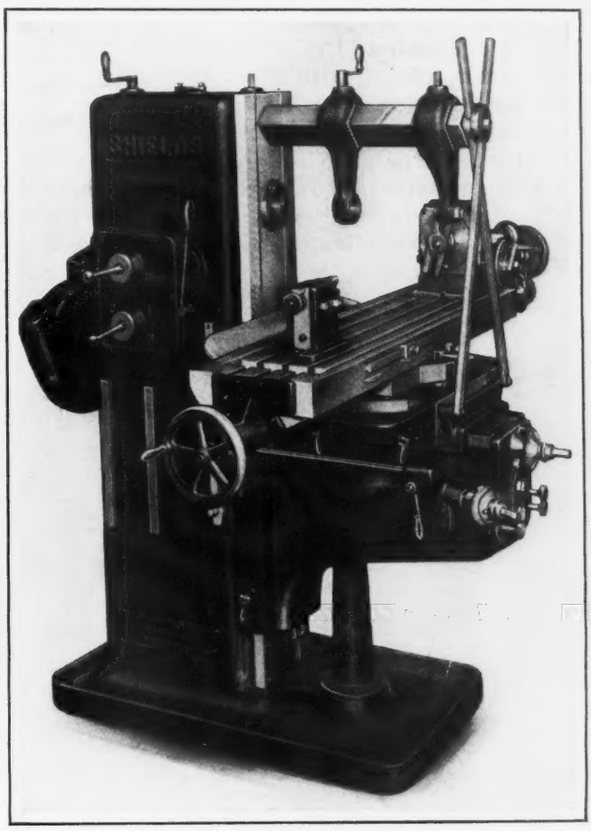
Both plain and universal machines are furnished with the standardized spindle nose, power feeds in all directions, a spindle reverse, a complete automatic coolant system with a centrifugal pump, and a patented saddle pan and extension shield. With the last-named feature, all slides, guides, and the floor are kept free from chips and flooding, as the saddle pan catches all coolant and drains it back to the reservoir. The enclosed coolant return eliminates all piping.

Each shaft of the machines, with the exception of the spindle, is equipped with ball bearings at both ends. The spindle is provided with a large phosphor-bronze bearing at the front end, and a ball bearing at the rear end. A patented square over-arm supports the arbor rigidly.

The feed mechanism is entirely enclosed in the knee, and there is complete control of feeds from the front of the knee. Eight feeds forward and reverse are obtainable in geometrical progression, and the gears are easily changed to give special feeds. The drive to the knee mechanism is direct from the main drive shaft, and is independent of the spindle speed. Universal shafts are eliminated in this feed drive by the use of a long gear.

The automobile type of gear shift is used for changing spindle speeds, there being eight speeds forward and reverse in geometrical progression. The spindle speed mechanism is mounted on a cover plate, fastened to the side of the column. With any speed or feed, there is only one train of gears in mesh. A flywheel on the drive pulley gives smooth transmission of power, and the main drive shaft is of full-floating design. The machine may be started and stopped from both sides through the operation of a simple clutch.

Accessibility is another feature of the construction. As an example, the friction feed drive, the clutch, and the spindle may be readily adjusted from the outside, the clutch and spindle drives being contained in the upper part of the column. Lubrication of the machine is entirely automatic, the column, knee, and saddle mechanisms running in oil baths. Feed-screws are mounted on ball bearings, and are equipped with 4-inch diameter dials which permit quick, accurate readings.



Shields Universal Milling Machine

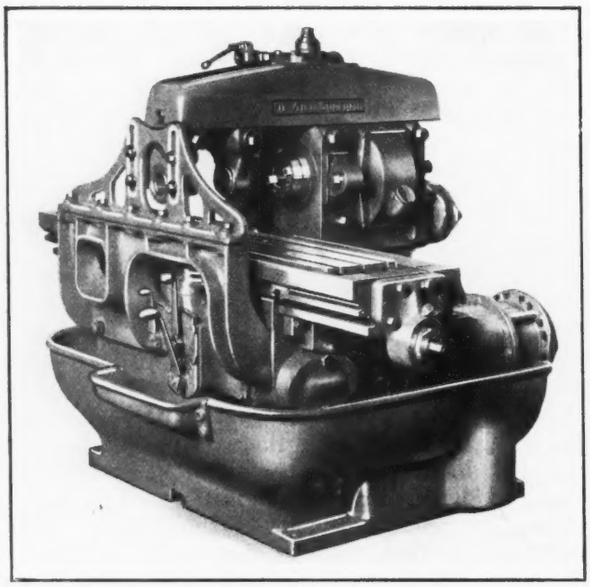


Fig. 1. De Vlieg "Supermil" Milling Machine

DE VLIEG "SUPERMIL" MILLING MACHINE

Among the many construction features embodied in a De Vlieg "Supermil" milling machine recently developed by the Walcott Machine Co., Jackson, Mich., two of the most important are hardened and ground tool-steel table ways and a large-diameter feed-screw with a thread of special design, which is hardened, ground, and lapped. While this machine has been designed primarily for use in high-production operations, it may be employed advantageously in small-lot milling when high accuracy is essential and heavy cuts are desirable. The tool-steel table ways are combined with a new type of gib construction and an automatic lubricating system, in order to insure a continued true plane of work travel.

Another important feature of the machine consists of a device with which the feed-screw may be equipped to eliminate backlash and make it possible to feed the work with or against the cutter rotation. Uniform thickness of chip per tooth is obtainable with this design. Other features of the machine include automatic flood lubrication, ground-tooth gears in the speed line, Timken tapered roller bearings throughout, a truss over-arm, a flange-type drive motor and splined shafts.

The main frame of the machine consists of three sections, one casting forming the base, chip pan, and coolant compartment, another comprising the bed with the table ways and mechanism housing, and the third consisting of the column and spindle head mounting. The table has a flat way at the front and a V-way at the rear. Interlocking rigid square gibs are used at the front and rear, each of these gibs being bolted in position with the heel resting on laminated shims. These shims permit adjustments for wear.

The flange-type motor which drives the machine is of 10-horsepower rating. As shown in Fig. 4, the motor shaft carries a pinion that meshes with a gear of the main-drive bracket unit. In addition to this gear, the main-drive unit comprises a multiple-plate disk clutch for starting and stopping the spindle, bevel gears for transferring the drive to a vertical shaft, a pinion for driving the feed and rapid traverse mechanism, and driving mechanism for the lubricating pump. The unit is self-contained on a plate that is bolted to the bed.

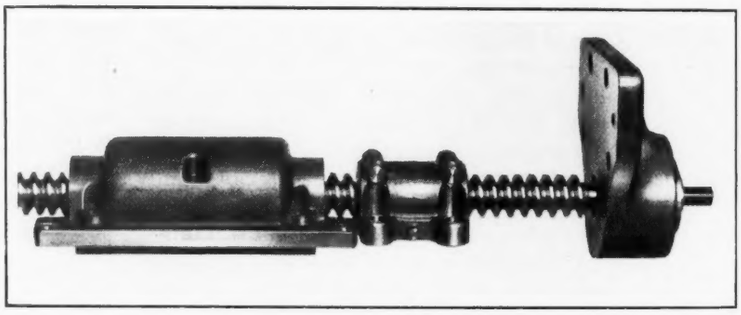


Fig. 3. Table Feed-screw which Has a Thread of Special Form that is Hardened, Ground, and Lapped

The spindle nose construction is in accordance with the standard adopted by the National Machine Tool Builders' Association. It is mounted on Timken tapered roller bearings in a quill which provides 2 inches of endwise adjustment. Accurate adjustments are obtainable by means of a sensitive worm mechanism. Power for driving the spindle is taken from the vertical shaft that extends from the main-drive bracket unit. Pick-off gears provide a range of spindle speeds from 20 to 180 revolutions per minute in the standard machine, but much higher speeds can be arranged for. The main spindle gear is sufficiently heavy to function as a flywheel. By the employment of gears with ground teeth, backlash is reduced to a minimum in the spindle drive.

The feed and rapid traverse mechanism is built in one unit, as shown in Fig. 2. Power feeds ranging from 1.8 to 21 inches per minute, and a power rapid traverse of 180 inches per minute are obtainable in either direction. Safety devices are provided to guard against damage to the machine in the event that the operator feeds or traverses the table into an obstruction.

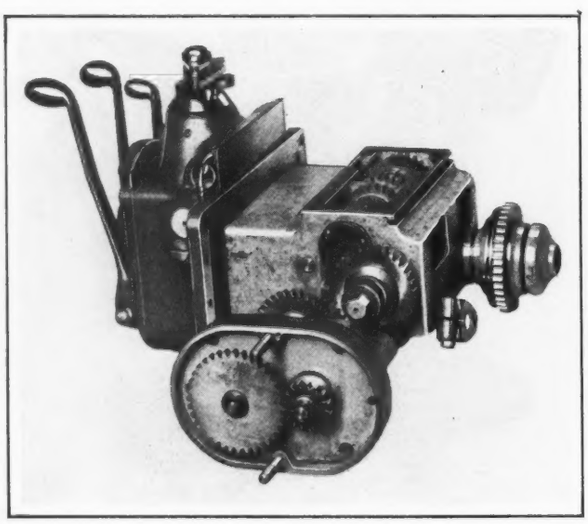


Fig. 2. Feed and Rapid Traverse Unit, Including Controls for the Entire Machine

The control box of the feed and rapid traverse unit carries the control mechanism for the entire machine, including levers for starting and stopping the spindle, for operating the feed in either direction, and for operating the rapid traverse in either direction. The rapid traverse is operative with the spindle running or stopped, but the feed can be engaged only when the spindle is in motion. The machine can be operated automatically or otherwise with the provision of proper trip-dogs.

The feed-screw is a departure from conventional types, being 2 inches in diameter and having a special form of thread, as shown in Fig. 3, with a 5/16-inch bearing on each side. The nut is made of a bronze having high wear-resisting qualities, and is automatically lubricated under pressure.

The table is 16 inches wide, and may be furnished for feed lengths of 24, 30, 36, or 42 inches. The minimum distance from the center of the spindle to the top of the table is 2 inches and the maximum distance, 14 inches. Vertical adjustment of the table is obtainable through a hand-operated screw equipped with a micrometer dial which facilitates accurate settings. Coolant is circulated

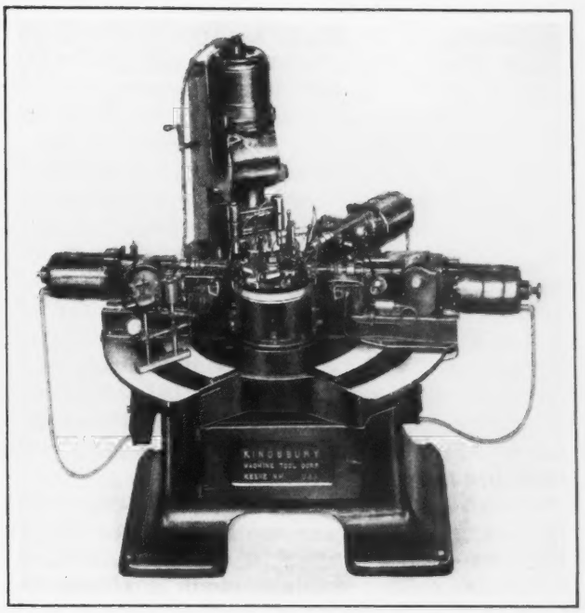


Fig. 1. Kingsbury Circular-type Machine with Standard Drilling Heads and Indexing Table

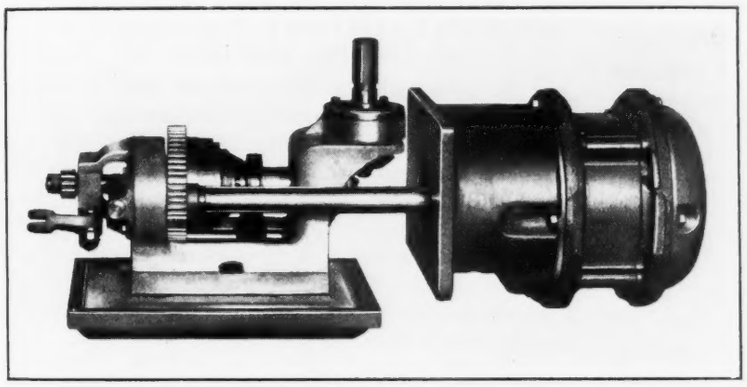


Fig. 4. Self-contained Driving Unit with Flange-type Motor

to the work and cutters at the rate of 30 gallons per minute by a geared pump having a separate motor drive. The entire machine, with the exception of the table end bracket, is automatically lubricated.

KINGSBURY CIRCULAR-TYPE DRILLING AND TAPPING MACHINE

Two styles of a multiple-spindle drilling and tapping machine of circular design which has recently been developed by the Kingsbury Machine Tool Corporation, Keene, N. H., are shown in Figs. 1 and 2. This machine is built up from standard units, including the Kingsbury drilling heads, with built-in motor and self-contained automatic feed, as well as a new automatic indexing fixture which is located in the center of the machine.

The work dial or table of this fixture is fastened to the top of a vertical shaft which is mounted in Timken tapered roller bearings. Inside of the frame casting are Geneva wheels, together with an automatically controlled plunger which engages bushings to position the table accurately after indexings. The fixture is operated from a gear-box mounted in the base of the machine. The drive is direct from a built-in 1/2-horsepower motor through a cone clutch and worm-gearing. This unit is controlled by means of an air-operated tripping device which, when released, permits the vertical drive shaft to make one revolution and then stop. An adjustable friction drive permits the clutch to slip under excessive resistance. This fixture can be furnished with either six or eight stations, and is 12 inches in diameter at the body.

Drilling and tapping heads up to 5/8 inch capacity can be mounted about the fixture horizontally, vertically, or at any intermediate angle. The No. 109 automatic burring spindle unit can also be installed for underneath countersinking or other light operations. It is shown at the right in

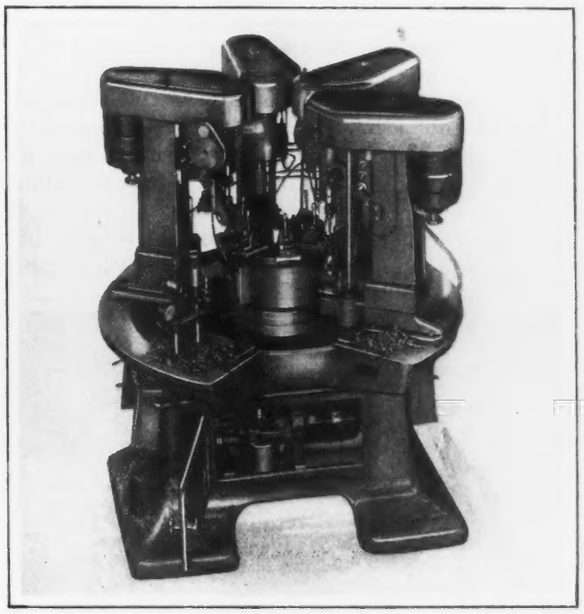


Fig. 2. Another Kingsbury Machine Arranged with One Vertical and Three Horizontal Drilling Heads

Fig. 2. The heads and the indexing mechanism are synchronized by means of air trips.

This machine can be run fully automatically or it can be furnished with a control valve which the operator trips for each machine cycle. Up to about 1800 cycles per hour may be obtained.

The machine is shown in Fig. 2 arranged for drilling and double-countersinking a cross-hole in the head of cap-screws, while in Fig. 1 it is arranged for drilling, counterboring, and tapping steel wedge nuts. The vertical head of the latter machine is equipped with an attachment for milling teeth in the sides of the nuts. On this particular job, the machine operates at the rate of six pieces per minute, the production being limited by the milling operation. If this operation were eliminated, the production would be increased to twelve pieces per minute.

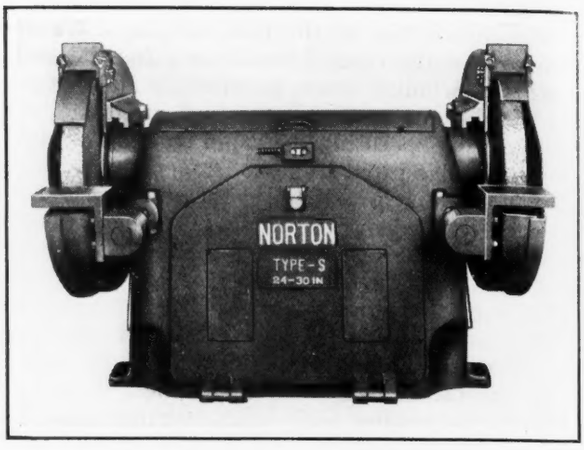
Several operations, such as drilling, counterboring, facing, and tapping can be performed on one hole, or several holes can be drilled, reamed, etc., at various angles. Multiple-spindle auxiliary drilling heads can be used. The circular bed is available in two sizes—52 and 72 inches in diameter.

NORTON HIGH-SPEED FLOOR GRINDER

A combination high-speed floor-stand machine which can be equipped with hoods for either 24- or 30-inch diameter wheels has been added to the line of grinding equipment built by the Norton Co., Worcester, Mass. The design of this type S machine hinges around the installation of a motor in the base, which makes possible the use of any standard alternating- or direct-current motor.

Overlapping steel guards made of 3/8-inch boiler plate, and complying with the safety code for wheels operated at 9000 surface feet per minute, are used for the wheels. These hoods are hinged and movable to compensate for wheel wear, movements being obtained by means of a rack-and-pinion mechanism and a ratchet wrench. Locking of the hoods in position or their release is accomplished through a cam and lever. Combination spark deflectors and protection hoods are furnished, with which the degree of wheel exposure can be controlled. The work-rests are supported from the base casting, and are adjustable in two directions.

Double-row adjustable ball bearings are provided for the spindle. Speeds are arranged to give new wheels a surface speed of 9000 feet per minute. Power may be transmitted from the motor to the machine through multiple V-belts, which allow three speed changes, or through a silent chain



Norton High-speed Floor-stand Grinding Machine

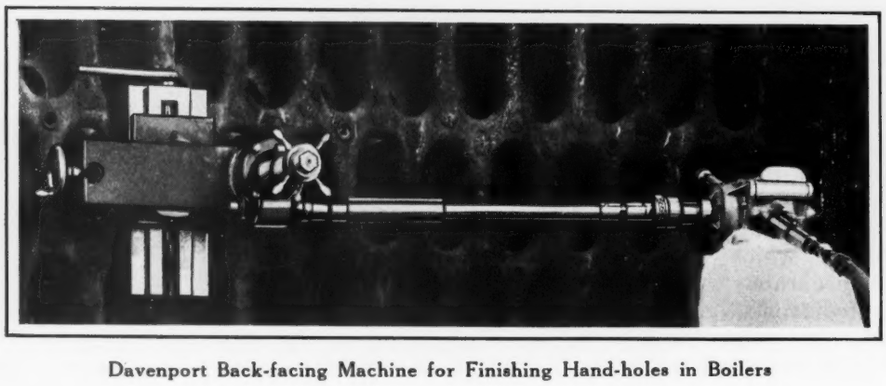
which does not allow for a speed change. For 30-inch wheels, a 15-horsepower motor is specified, and for 24-inch wheels, a 10-horsepower motor. Lubrication of the entire machine is accomplished through four Alemite connections.

DAVENPORT PORTABLE HAND-HOLE BACK-FACING MACHINE

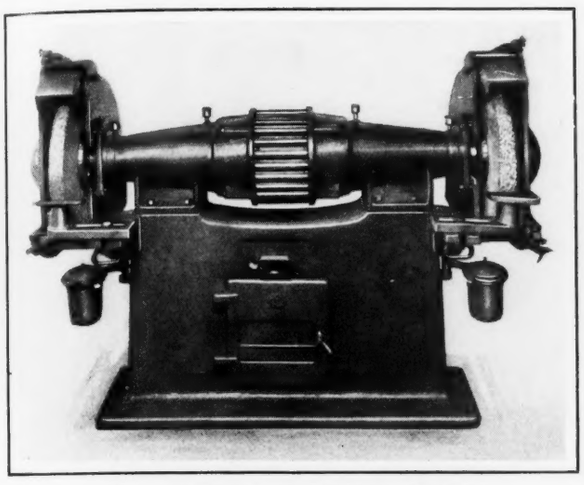
A portable machine designed for back-facing the inside of hand-holes in steam boilers in order to obtain an accurate bearing seat for the hand-hole cover, is a recent product of the Davenport Mfg. Co., Meadville, Pa. This machine consists primarily of a spindle for holding a cutter, the spindle being incorporated in a cross-slide mounted on a base that can be clamped to the face of boilers. A universal-joint drive provides for the use of an electric or air drill as the source of power.

Longitudinal travel of the cross-slide on the base is accomplished through a ratchet feed. The transverse travel of the cross-slide is universal. This combination of movements makes it possible to bring the spindle into position above the hand-hole after the machine has been clamped to the boiler. The spindle with the cutter attached can then be lowered into the hole by means of the nut feed which is also employed to bring the cutter quickly into contact with the work. A hardened collar next to the cutter and larger in diameter than the spindle bears against the rim of the hole and protects the spindle from damage. The thrust is taken by a ball bearing at the top of the feed-nut.

The driving shaft is connected with the spindle through worm-gearing. By loosening four nuts, the worm housing can be adjusted to four different positions so as to accommodate the driving shaft from four different angles. This adjustment permits locating the drill which supplies the power in the most convenient position for the job. This machine can also be made without the worm drive for use under the spindle of a drilling machine.



Davenport Back-facing Machine for Finishing Hand-holes in Boilers



Diamond Floor-type Grinding Machine

DIAMOND FLOOR-TYPE GRINDING MACHINE

Twenty-inch wheels, spaced 54 inches apart, are provided on a floor-type grinding machine recently brought out by the Diamond Machine Co., 9 Codding St., Providence, R. I. This spacing of the wheels allows ample room for two men to work at the machine simultaneously without interfering with each other. The wheels are 2 inches thick.

A double pair of ball bearings is provided at each end of the machine. The motor employed for driving this grinder is of 7 1/2 horsepower capacity and runs at 1150 revolutions per minute. It has a corrugated frame with special end pieces that provide for through ventilation. Vent holes are furnished in the column. The machine is equipped with a magnetic switch and with a start-and-stop push-button station. Heavy wheel guards which conform to the safety code are furnished, and these guards have wings that are adjustable to compensate for wheel wear. The height from the floor to the center of the spindle is 32 inches.

WICKES ENGINE LATHES

Completely redesigned geared-head engine lathes designated as "extra heavy duty," are being placed on the market by Wickes Bros., Saginaw, Mich., in 42-, 48-, and 60-inch sizes. Ball or roller bearings are provided throughout, with the exception of the main spindle bearings. All sliding gears in the headstock are mounted on splined shafts.

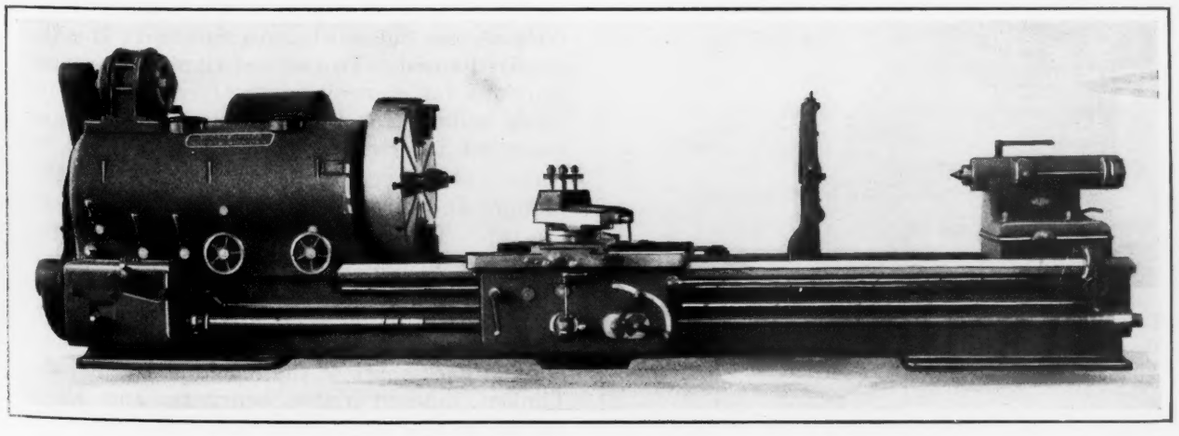
Levers on the front of the headstock provide for the selection of sixteen spindle speeds ranging from 2 to 200 revolutions per minute. The handwheel at the extreme right-hand end of the headstock is employed for engaging or disengaging the triple-geared faceplate drive. Through the faceplate drive, spindle speeds from 2 to 50 revolutions per minute are obtainable, the direct-drive spindle speeds ranging from 8 to 200 revolutions per minute. Reversal of the lead-screw to permit cutting left-hand threads is accomplished by operating the lever at the extreme left-hand end of the headstock. Lubricant is supplied to each headstock bearing by a geared pump submerged in oil, and the gears run in an oil bath which provides a splash system in addition to the pressure system.

For the main drive a constant-speed motor of 1200 revolutions per minute is recommended. The motor may be mounted on the headstock or on the floor at the back of the lathe. Power may be delivered to the machine through a belt (equipped with a tightener), a silent chain, or gearing.

The main drive clutch is of the design used on other Wickes engine lathes, rapid-production lathes, and crankshaft turning lathes. It consists essentially of a driving ring with fiber inserts, an outside driving plate, an inside driving plate, and means for clamping the friction inserts between the two driving plates. This clutch may be readily adjusted for wear from the outside of the clutch housing, without removing of covers or other parts. Movement in one direction of a lever at the operator's position, engages the driving clutch, while a reverse motion of the same lever disengages the clutch and engages a friction brake.

The quick-change gear-box provides a wide range of feed and thread changes. Longitudinal feeds range from 0.024 to 0.723 inch per spindle revolution, and cross-feeds from 0.009 to 0.271 inch per spindle revolution. Power rapid longitudinal traverse for the carriage, as well as power rapid cross traverse, may be provided. Levers on the apron which are provided for engaging and disengaging the bevel pinion for the carriage power feed and the nut on the lead-screw, are so interlocked that it is impossible to move either lever unless its companion is in the neutral position.

A taper attachment of improved design is permanently bolted to the back of the carriage, where it is always ready for use. This attachment has



Wickes Geared-head Engine Lathe with Triple-geared Faceplate Drive

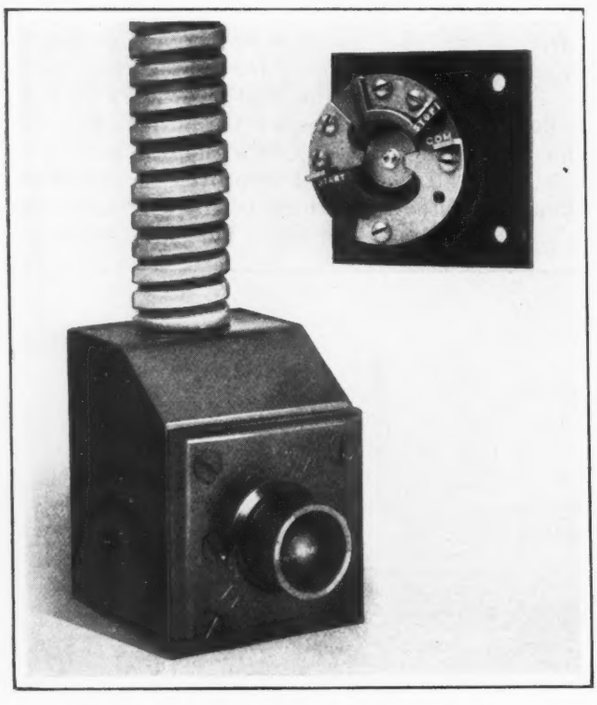
a range of 2 inches of taper per foot on either side of the center line, and a travel of 30 inches in length with one setting. Beds are cast in one piece up to 30 feet 6 inches in length, while longer beds are made in two pieces with the joints machined, bolted, and doweled together. Equipped with beds 16 feet 6 inches long, the 42-inch lathe weighs 41,000 pounds; the 48-inch lathe, 42,200 pounds; and the 60-inch lathe, 45,000 pounds. The actual swing over the bed is 44, 51 1/2, and 61 inches, respectively.

LINCOLN SAFETY PUSH-BUTTON SWITCH

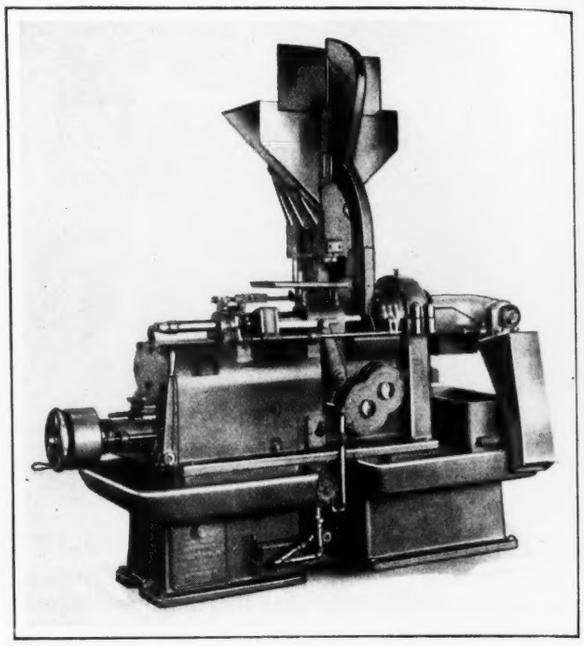
The safety-type push-button switch here illustrated has recently been developed by the Lincoln Electric Co., Cleveland, Ohio. This device has a ball-top start-button which is contained inside a large stop-button that projects over the start-button and thus protects it from accidental contact.

The start-button can only be operated by the tip of a thumb or finger inserted inside the stop-button, while the latter can be operated by a finger or palm of the hand. The start-button is a vivid green molded bakelite part, with the word "start" in white letters across the ball top. The surrounding stop-button is a brilliant red molded bakelite part. The exterior of the case is jet black.

The inner mechanism is enclosed in an arc-welded steel box measuring 2 1/2 by 3 1/4 by 2 1/2 inches. All insulating parts are made of bakelite. Another feature of the switch is the ease of installation. Four screws hold the bakelite faceplate to the container, and by merely removing these screws, the entire operating mechanism can be taken from the case for wiring. The combining posts are plainly indicated by white letters on the black bakelite, to prevent chances of errors in making connections. This switch is suitable for use with any type of push-button starter.



Lincoln Push-button Switch with Safety Features



"Threadnut" Large-sized Nut Tapping Machine

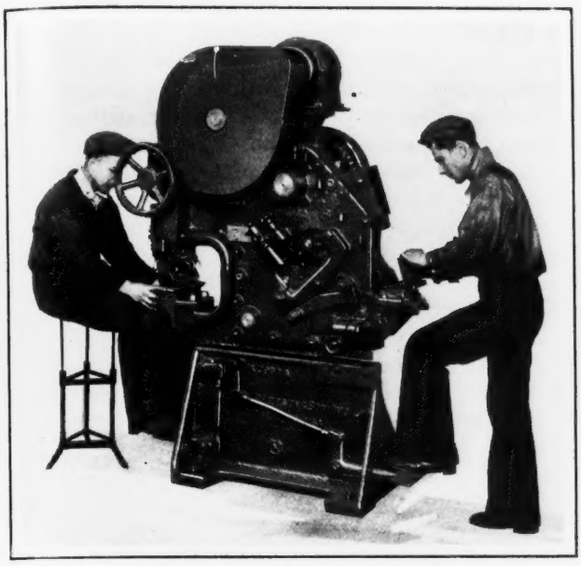
"THREADNUT" NUT TAPPING MACHINE

A hydraulically operated hopper with a plunger-type feed is a feature of the "Threadnut" No. 3 nut tapping machine recently developed by the Automatic Nut Thread Corporation, 3617-19 N. 8th St., at Rising Sun Ave., Philadelphia, Pa. This machine is designed along the same general lines as other "Threadnut" machines, but is of larger size. Production rates range from 642 nuts per hour of 7/8-inch size with a U. S. standard thread to 366 nuts per hour of 1 1/2-inch size with a U. S. standard thread.

The machine is fully automatic, the nuts being merely loaded into the sheet-steel welded hopper. A safety clutch throw-out is provided to automatically stop the machine in case any obstruction prevents a nut from being fed on the tap. After the obstruction has been removed from in front of the plunger, the clutch automatically goes into action again, so that the machine can be started by simply moving the clutch lever. The safety clutch reduces to a minimum chances of tap breakage.

Taps of the bent-shank type are used, and they are held in a floating position by a train of nuts on the shank. Change-gears, operated from controls at the end of the machine, give the various required speeds. Two sets of change-gears are also provided for controlling the feeding cam, one set being suitable for U. S. standard threads and the other set for S. A. E. threads.

Coolant is fed under pressure through the plunger and directly into the tapping jaws and to the tap. The coolant tends to keep the tap from becoming heated and assists in washing away chips. The machine is also equipped with a forced-feed lubricating system which carries oil to all moving parts through small feed lines. The spindle and back-shaft of the machine are mounted on Timken tapered roller bearings, and all other shafts on the machine are equipped with double-row ball bearings.



Ryerson Combination Shear, Punch, and Coper

RYERSON COMBINATION SHEAR, PUNCH, AND COPER

A smaller design of combination shear, punch, and coper than that described on page 244 of November, 1927, MACHINERY, has now been introduced to the trade by Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill. The new model is intended for performing various operations on the smaller steel sections, including the punching of various sections, the shearing of plates and bars, the cutting of angle- and T-sections, the mitering of angle- and T-sections, and the coping and notching of various shapes.

The punch has a deep throat for receiving most styles of structural shapes, and will punch 11/16-inch holes through 1/2-inch plate. Operation of the punch is not interfered with by the other units built into the machine. The shearing end of the machine is so constructed that a single slide handles the shearing of angle-irons or plates, the cutting of bars, and the coping of sections. The angle shear attachment does both inside and outside miter cutting, as well as straight shearing. The blades in this unit are made in sections to provide for easy and cheap replacement.

The bar cutting blades handle both round and square sections and are located directly below the angle shear blades. These cutters consist of two blades only. Plate shearing blades are located directly beneath the bar cutter. They handle plates of any width or length and up to 3/8 inch in thickness. The coping device is located at the shear end of the machine, extending outward from the frame at a convenient height. A V-notch type of coping device is regularly furnished, but the square notching feature can be provided.

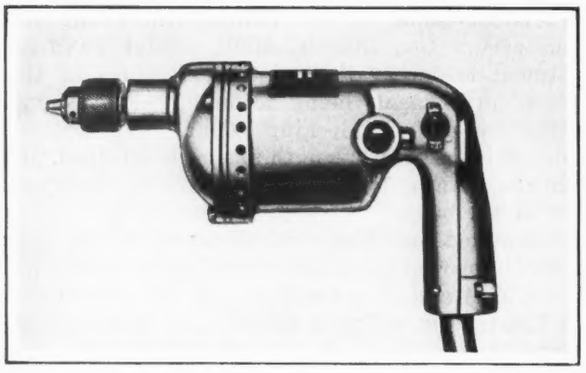
ECLIPSE IMPROVED QUICK-ADJUSTABLE-LENGTH HOLDER

An improved type of extension holder which is particularly adapted to multiple-spindle spot-facing, counterboring, countersinking, or core-drilling to specified depths is the latest addition to the line of products made by the Eclipse Interchangeable Counterbore Co., Detroit, Mich. Quick hand adjustment is one of the principal features of this holder, adjustments being accomplished by simply lifting the knurled locking collar, revolving the body until the proper length has been obtained, and then re-engaging the knurled collar with the upper part of the body.

Assembled and disassembled views of one type of this improved quick-adjustable-length holder are shown at *A* and *D*, respectively, in the accompanying illustration. This type has a ratchet adjustment, which gives a length variation of 0.004 inch by simply moving the collar through a distance of one notch. This holder can be used in a right-hand direction only, and is known as the "R" type. At *B* and *C* is shown another holder known as the "SD" type, the collar of which has square driving lugs which permit the holder to be driven either right- or left-hand. The adjustment obtainable with this holder is about 0.008 inch per notch. Each holder consists simply of a shank, sliding collar, and holder or sleeve.

In the few cases where a tool of this type might be used in a turret lathe or in a horizontal position in a multiple-spindle drilling machine, a set-screw is provided in the collar for maintaining positive engagement. However, in the vast majority of operations, the tool is used vertically, and gravity keeps the collar in positive engagement except when purposely lifted by hand. With the locking collar located at the upper end of the holder body, the tool is especially suitable for being guided in a fixture bushing, as there is a long uninterrupted bearing surface in which oil-grooves can be milled if desired.

Eclipse Holder which is Quickly Adjustable for Length by Hand



Van Dorn 1/4-inch Light-duty Electric Drill

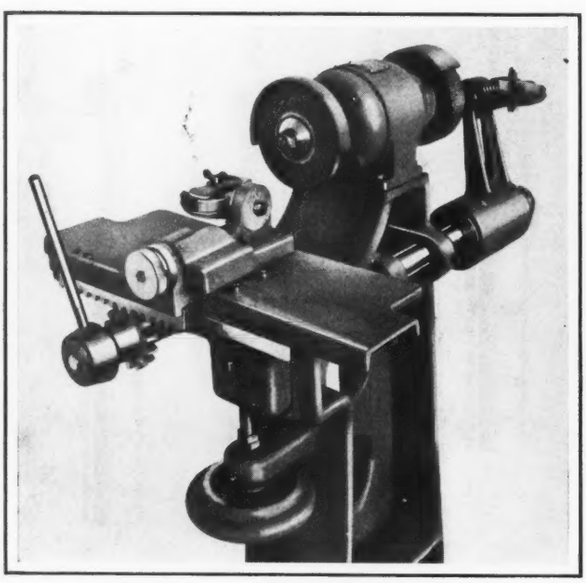
VAN DORN LIGHT-DUTY ELECTRIC DRILL

A 1/4-inch light-duty portable electric drill recently developed by the Van Dorn Electric Tool Co., Cleveland, Ohio, is shown in the accompanying illustration. This drill is not intended for continuous-production drilling, but rather as a serviceable tool for intermittent work. It is especially intended for use by electricians, plumbers, carpenters, mechanics, etc., and in automotive shops.

The handle design and reduced length make the tool particularly useful in close corners, and it can be conveniently placed in the tool-kit. It is equipped with a universal motor for operation on either direct or alternating current.

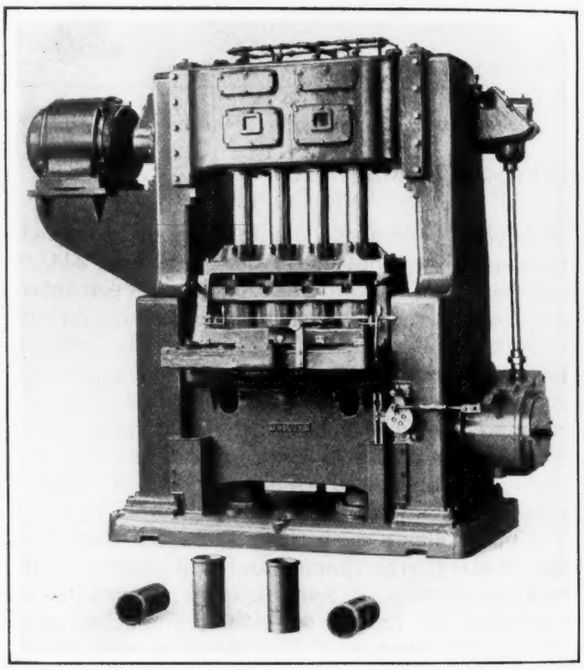
JONES & LAMSON CHASER GRINDER

Quicker and more accurate means of sharpening the chasers of automatic die-heads made by the Jones & Lamson Machine Co., Springfield, Vt., are provided by a special grinder now being introduced on the market by that concern. This special grinder, which is here illustrated, is driven by a 1/4-horsepower motor mounted on a pedestal which occupies 20 by 20 inches of floor space. The motor is of ball bearing construction, runs at 3450 revolutions per minute, and is operated by 110-volt, 60-cycle current, unless otherwise specified. All working parts of the machine are protected from emery dust.



Jones & Lamson Special Grinder for Automatic Die-head Chasers

The two distinct grinding operations are arranged for by designing both sides of the grinder for independent set-ups. Micrometer adjustments reading to thousandths of an inch are furnished on each side and on the vertical elevating screw. Parts of the regular Jones & Lamson chaser-sharpening fixture are employed to permit proper holding of the chasers. These also provide an angular adjustment on the swinging slide for chamfer and an angular adjustment on the horizontal slide for top rake angles. The position of the pinion handle employed for operating the horizontal slide is adjustable by merely withdrawing the pinion from the rack and placing the handle to suit the slide travel.



Defiance Boring and Reaming Machine for Cylinder Sleeves

DEFIANCE BORING MACHINE FOR TRACTOR CYLINDER SLEEVES

Cylinder sleeves of the types used in tractors and gas engines may be rough-, semi-, or finish-bored or reamed, four at a time, in a machine recently built by the Defiance Machine Works, Defiance, Ohio. This special extra heavy No. 8 cylinder-sleeve boring machine gives a production of from 50 to 100 sleeves per hour in any operation. In general design, the machine closely follows the one described on page 555 of March, 1928, MACHINERY; the frame and base castings, as well as the feed mechanism, the hand feed adjustment, the spindle drive, method of attaching the boring tools, and the jack-screws, are the same as on the previous machine.

The center section of the work fixture with which the new machine is equipped is mounted on a sliding table operated by an air cylinder in opening and closing. The cylinder is equipped with a pressure gage and an air reducing valve intended to be set at a 60-pound pressure for reducing the pressure of the air received from the main-line intake. The main line pressure may be 100 pounds

per square inch, or any amount in excess of 60 pounds per square inch. The top of the fixture is supported by the bushing plate. Hardened jig eyes pilot the boring-bars before they start the cuts.

From 15 to 25 horsepower is required to drive this machine. It occupies a floor space of 48 by 118 inches, and has a net weight of 18,000 pounds.

"MANSAVER" AUTOMATIC TAPPING AND SCREWDRIVING MACHINE

Pieces as large as 12 by 8 by 6 inches can be handled in a "Mansaver" automatic tapping machine now being placed on the market by the J-B Engineering Sales Co., New Haven, Conn. Pro-

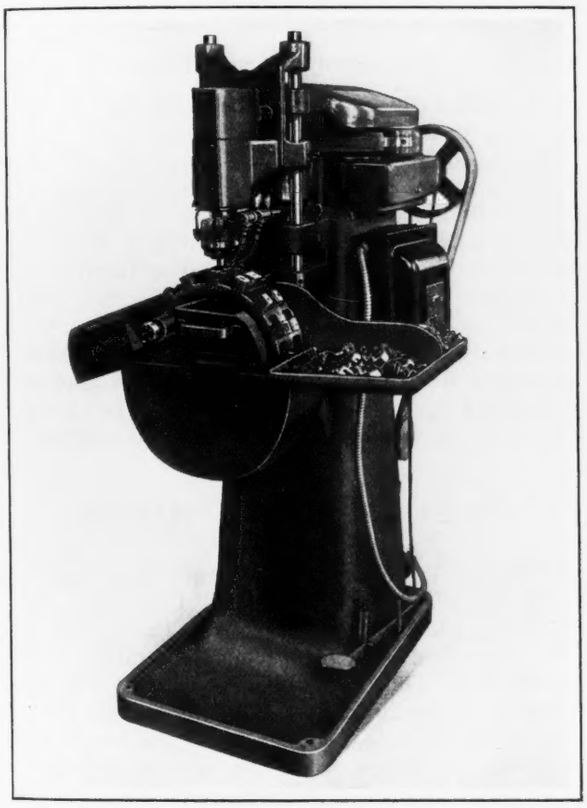


Fig. 1. "Mansaver" Tapping Machine with Drum Feed

duction rates vary from 20 to 80 pieces per minute. The essential elements of this machine consist of tapping heads and the feeding mechanism. The location of the tapping heads is adjustable to suit the work. Any number of holes up to eight can be tapped in a single-head machine, but owing to the method of feeding, the number of holes may be increased by employing a double- or triple-head machine.

The tapping heads are driven by a reciprocating rack-and-pinion drive and intermediate spur gears. The spindles are positively driven, but they are so arranged with a compensating head that each tap follows its own lead, thus permitting the use of different sized taps in the same machine. The main drive consists of a hardened and ground nickel-steel worm mounted in ball bearings, which meshes with bronze gears and is driven either by belt or by a motor.

Automatic feeding of the parts to be tapped is performed by means of a conveyor, drum, or push

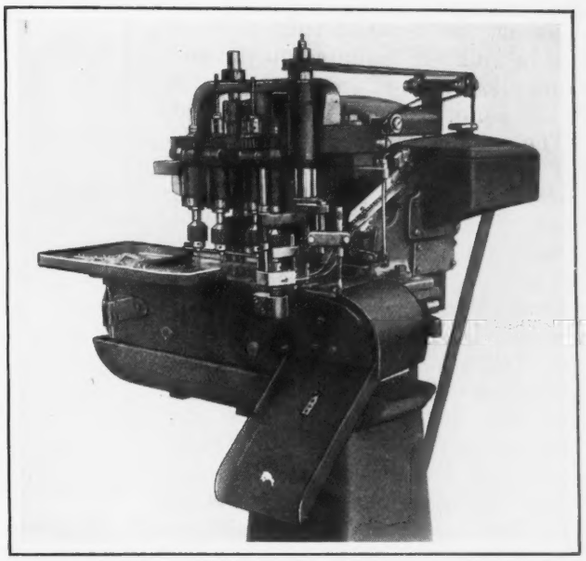


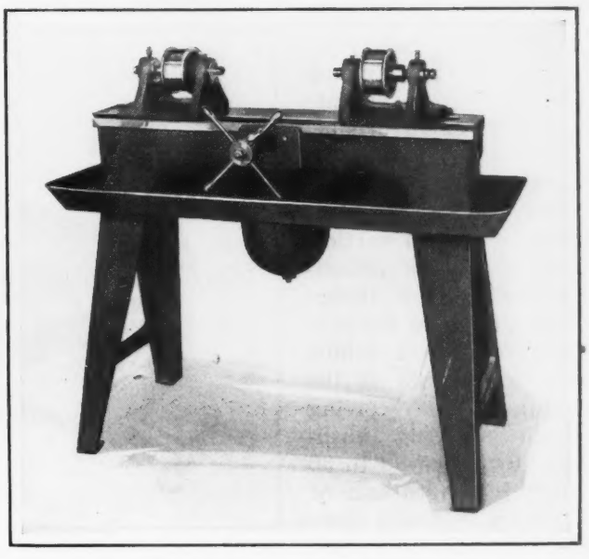
Fig. 2. Tapping Machine Equipped with Conveyor Work Feed

mechanism, these mechanisms being specially designed for the piece. Fig. 1 shows a machine provided with a drum feed, and Fig. 2, another machine equipped with a conveyor feed. An oil-pump can be furnished for delivering cutting compound to the taps from a reservoir inside the bed.

A screwdriver head and special upsetting heads can also be supplied. With the screwdriver head, the slot in the screws is located opposite the screwdriver, before feeding. This eliminates scratching of the screw head and burring of the screw slot. Screws can be driven either part way or all the way into holes. They can be staked or spun after insertion.

FREW DUPLEX DRILLING MACHINE

The No. 0 duplex horizontal drilling machine here illustrated is being placed on the market by the Frew Machine Co., 132 W. Venango St., Philadelphia, Pa. This machine is designed for performing drilling, counterboring, turning, hollow-milling, facing, and similar operations simultane-



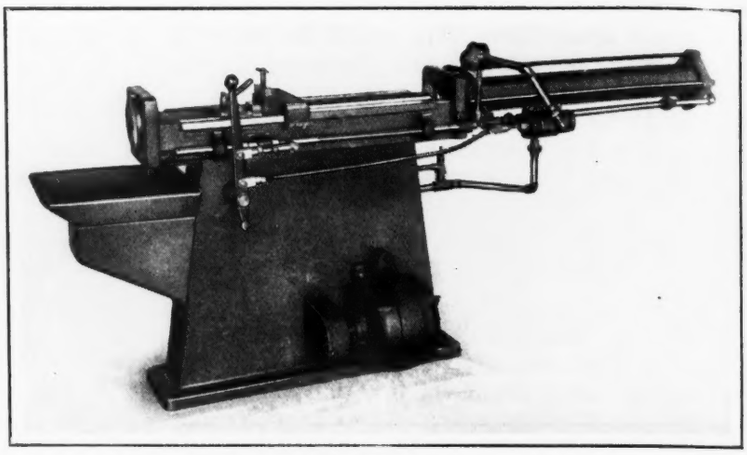
Frew Duplex Horizontal Drilling Machine

ously, on the opposite ends of work held in a fixture mounted on the bed. Numerous types of fixtures operated by air, hand, or foot can be employed.

The spindle heads are fitted to the bed on a dovetailed way provided with an adjustable gib for taking up wear. The spindles are carried in Timken tapered roller bearings, but ball bearings can be furnished when desired. Stops on the machine can be regulated to control the depth of cut. Felt wipers on the heads clear chips from the bed.

Several methods of feeding the heads are available. With the hand screw-feed illustrated, the operator simply turns the capstan wheel to move both heads simultaneously toward or away from each other. Bevel gears revolve a lead-screw which runs through the machine. Feeding of the heads may also be accomplished by means of individual levers provided for each head or by means of a single lever. The lead-screw type of machine can also be furnished with a power feed.

Individual motor drives may be supplied for each head, the motors being built into the heads and geared to the spindles. This machine has a capacity for drilling holes up to 9/16 inch in cast iron. The swing over the bed is 9 inches, and the maximum distance between spindle ends, 23 1/2 inches.



American Two-ton Hydraulically Operated Horizontal Broaching Machine

any desired stroke. Movement of the ram is controlled by means of a balanced piston valve.

The machine operates at a pressure of 350 pounds per square inch, a direct-reading gage indicating the amount of pressure that is applied. A motor of 2-horsepower rating running at 1800 revolutions per minute is recommended by the builder. An oil tank having a capacity of 5 gallons is built into the back of the base.

Lubricating oil is fed to the cutting tools by means of a Brown & Sharpe pump. This machine requires an operating floor space of 9 by 4 feet, and has an approximate weight of 1400 pounds.

AMERICAN HORIZONTAL HYDRAULIC BROACHING MACHINE

A 2-ton horizontal hydraulic machine recently added to the line of broaching equipment built by the American Broach & Machine Co., Ann Arbor, Mich., is here illustrated. This No. 0 machine is arranged for a motor drive only, the pump being driven through a Link-Belt chain and sprockets. The machine is equipped with a 4-inch steel cylinder, the piston of which is provided with two step-joint piston-rings and a leather-cup. The pulling ram is 1 1/2 inches in diameter, and is operated at a speed of 18 feet per minute, with the pump shaft running at 600 revolutions per minute. The machine can be arranged to operate at any speed in production, by changing the pump shaft speed.

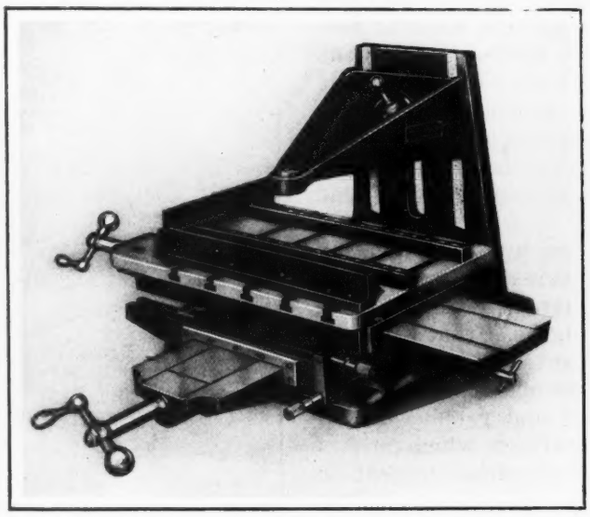
The sliding head is equipped with a vertical slide having an adjustment of 1 1/2 inches above and below the center. There is a 5-inch bore in the face of the machine for receiving broach reducing bushings. Broaches up to 30 inches in length can be accommodated, and there are automatic stops which can be set to give

CRALEY LARGE-SIZED "MASTER TOOLMAKER"

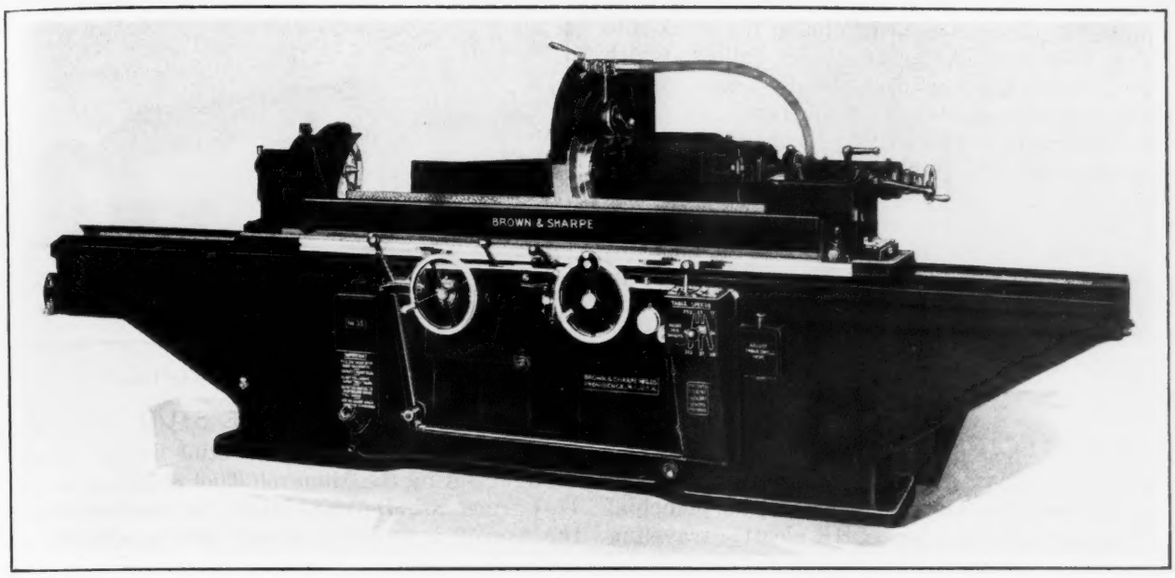
A "Master Toolmaker" has recently been brought out by the C. C. Craley Mfg. Co., Post Office Box 192, Shillington, Pa., which is twice the size of the model described on page 73 of September, 1926, MACHINERY. The new model has a work-table measuring 14 by 20 inches. The longitudinal movement of the table is 18 inches, and the transverse movement, 12 inches, while the vertical movement can be made to meet requirements.

Various improvements have been incorporated in the larger model. For instance, both screws for adjusting the table are equipped with two ball thrust bearings. There are four felt wipers for oiling and cleaning the bearings. Adjustable parallel strips are provided on the table to suit the different sizes and shapes of work to be machined. These strips are clamped to the table by means of socket-head cap-screws and nuts which enter T-slots in the table. The strips are provided with a series of tapped holes for use in clamping work.

Two arms or bushing supports are furnished, one accommodating stan-



Craley "Master Toolmaker" of Improved Design and Increased Size



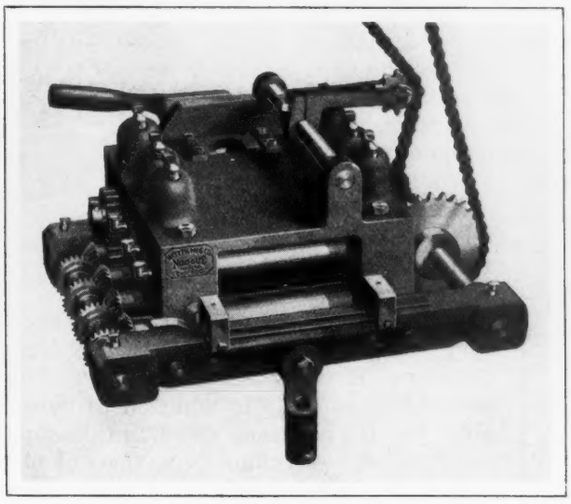
Brown & Sharpe Plain Grinding Machine which Takes Work 72 Inches Long between Centers

dard bushings having holes from 3/16 to 5/8 inch in diameter, and the other having holes from 5/8 to 1 inch in diameter. Both arms are interchangeable so that holes of any size may be machined in accurate relation with each other. This "Master Toolmaker" weighs 400 pounds complete.

BROWN & SHARPE PLAIN GRINDING MACHINE

Work up to 72 inches in length can be accommodated between the centers of a No. 35 plain grinding machine recently added to the line of machine tools built by the Brown & Sharpe Mfg. Co., Providence, R. I. This machine, except for size, is similar in every way to the Nos. 30, 32, and 33 machines described on page 787 of June, 1928, MACHINERY. The floor space dimensions of the new machine are 74 by 189 inches. As on the previous machines, the footstock and headstock centers swing work 12 inches in diameter with a 24-inch wheel, and work 6 inches in diameter with a 30-inch wheel.

The group of machines to which this new size belongs has an unusually wide range of table and work speeds, high table speeds, and conveniently grouped controls. Changes of speed in the totally independent work drive and table movement are made through sliding gears and individual levers. Another feature of the machines consists of complete lubrication of the wheel spindle and of all main mechanisms by a gravity flow of filtered oil from a reservoir that is kept flooded by a geared pump. Either an overhead countershaft drive with a single pulley or a motor-in-base drive by one motor only can be provided. From 15 to 40 horsepower, depending upon the work, is necessary to drive the machine.



Wittek Automatic Stock-feeding and Straightening Mechanism

WITTEK PUNCH-PRESS STOCK-FEED

A combination straightening and feeding device designed for feeding stock to punch presses has recently been added to the line of products made by the Wittek Mfg. Co., 2532 S. Kedzie Ave., Chicago, Ill. This stock feed is equipped with a series of staggered rollers which perform the double function mentioned.

Power for driving this feed is delivered by a chain which runs over a sprocket mounted on the crankshaft of the press and a sprocket on the feed that is of a suitable diameter to give the desired timing. The sprocket on the feed is mounted on a back-shaft from which the drive is delivered through a pair of bevel gears to the front rolls of the feed and then to an intermediate driving shaft from which power is taken by bevel gears for driving each of the lower stock rollers continuously.

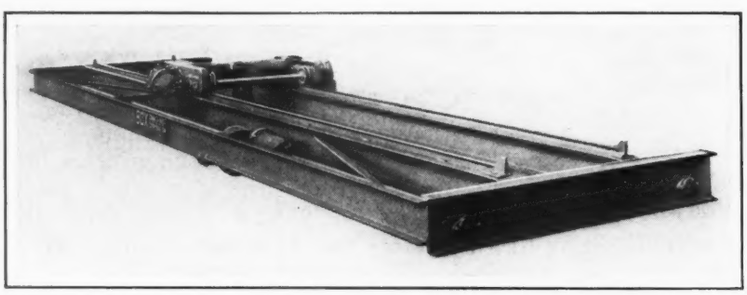
Obviously, feeding of the stock must be intermittent to permit the performance of the press operation as the dies come together. Intermittent feeding is accomplished by having the upper rollers of the straightening and feeding mechanism carried in floating bearings. When the press ram comes down, it strikes an adjustable trip mechanism, which lifts the upper rollers in their bearings, against the tension of coil springs. Feeding of the stock is then ended until the ram has again receded sufficiently to bring the two die members out of engagement. At this time, the springs press

the upper rollers downward to bring the stock into firm contact with the lower driven rollers, which again advance the stock into the die ready for the next downward movement of the ram.

The operation of the feeding mechanism is fully automatic, so that after a reel of stock has been started into the die of a press, the feeding and straightening continues without requiring any attention from the operator. The feed is made in two sizes to take stock up to 6 and 12 inches in width. Different combinations of sprockets and adjustments provide any feeding length per stroke of the press from 0 up to 30 inches.

BOX ELECTRIC TRAVELING CRANE

Operation within a small amount of space and improved hook approach are two of the principal features claimed for a type LHR electric traveling crane recently developed by the Box Crane & Hoist Corporation, Philadelphia, Pa. Increased speed with smooth operation and ease of control, are also features of the design.

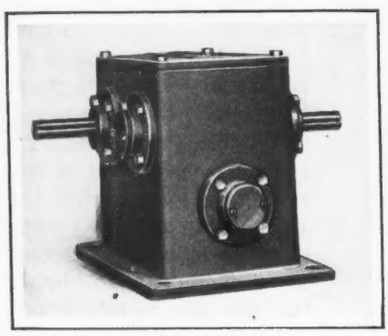


Box Electric Traveling Crane Requiring Low Headroom

The new crane has been designed for service in buildings having a minimum height of 10 feet, storage space to within 24 inches of the ceiling being permitted. The crane is fully standardized in one frame size only for capacities of 1, 2, and 3 tons and spans up to 50 feet. It is of all-steel arc-welded construction.

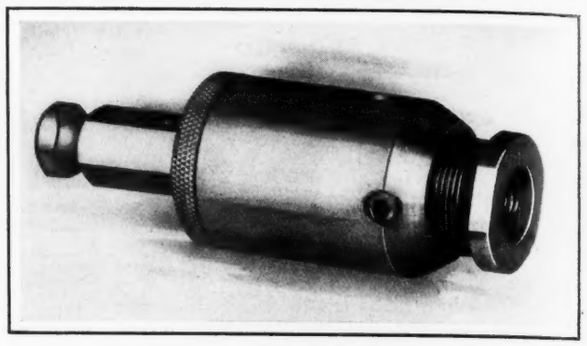
"WHS" REDUCING GEAR

The latest addition to the line of gear reduction units built by Winfield H. Smith, Inc., Springville, N. Y., is a No. 4-D reducing gear, made in reduction ratios ranging from 100 to 1 up to 2500 to 1. It is driven through double worm-gearing, the driving and driven shafts being parallel. Ball thrust bearings are provided at each end of the two worm-shafts.



Gear Reducer Made by Winfield H. Smith, Inc.

Because of the large reduction ratios, the actual horsepower ratio of the unit is very small, and therefore it is particularly suitable for light conveyor drives where a large speed reduction is required.



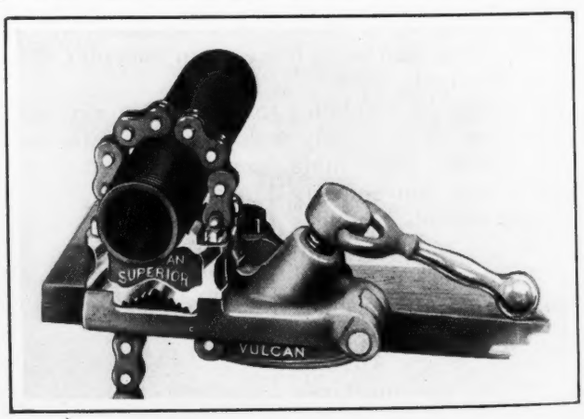
Stud Driver with Replaceable Insert

MONARCH INSERT-TYPE STUD DRIVER

Long life of an improved stud driver recently brought out by the Monarch Tool & Mfg. Co., 2704 E. Larned St., Detroit, Mich., is insured through the use of a tool-steel insert at the stud-driving end. The insert screws into a threaded hole in the body of the device, and is held in place by means of a headless set-screw, the construction being obvious in the accompanying illustration. Inserts are readily replaced as they become worn, and the device proper will outlast a dozen or more of the inserts. Various types of shanks—square, hexagonal, or tapered—can be provided on the driver to meet requirements. Several sizes of the tool are made.

WILLIAMS' CHAIN PIPE VISE

Overhead adjustment and reversible jaws are two principal features of the "Vulcan Superior" chain pipe vise recently placed on the market by J. H. Williams & Co., Buffalo, N. Y. The overhead adjustment is obtained by locating the handle on top where it can be operated with ease. The reversible jaws provide for longer life of the vise, as when the



Williams Chain Pipe Vise with Reversible Jaws

teeth first in use become worn, the jaws can be easily reversed by simply unscrewing the bolts, to bring a second set of teeth into position for service.

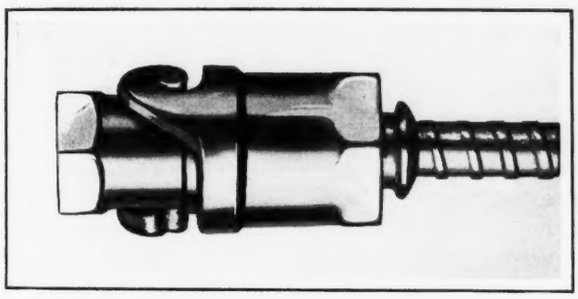
In addition to these features, the maker states, each vise will take pipe 1/2 inch larger than other chain pipe vises of similar size. The base, jaws, handle, and chain arm are all steel drop-forgings. The chain is of the same quality as that used on "Vulcan" chain pipe tongs. This vise is made in

two sizes to accommodate pipe from 1/8 to 4 1/2 inches. Both sizes are chromium-plated to give them an attractive finish. They are of compact design, quick-acting, and give a positive grip.

ROBINSON "MIDGET" AIR-HOSE COUPLING

One-quarter turn of a "Midget" plain-type air-hose coupling, manufactured by the Robinson Machine Co., Muskegon, Mich., is sufficient to connect or disconnect the coupling. This device has no springs or loose parts. It is equipped with a special leather gasket that is not affected by oil or other air-line substances and that is expanded by means of a V-shaped sliding ring when pressure is applied. A nut adjustment permits compensation for wear.

This coupling weighs less than 8 ounces, is 1 inch in diameter, and, with the hose shank, measures 3 1/2 inches over all. It is made interchangeable in 1/4- and 3/8-inch sizes for pipe and hose lines. Each coupling is tested at an air pressure of 100 pounds per square inch to make certain that



Robinson Air-hose Coupling Made in 1/4- and 3/8-inch Sizes

it is air-tight. These couplings are particularly suitable for use with paint spraying equipment or where quick changes are necessary.

PORTER-CABLE CORE-PRINT GAGE AND PORTABLE SAW

Two new devices, a core-print or circle-generating gage and an improved portable saw, have recently been added to the products of the Porter-Cable Machine Co., Syracuse, N. Y. The core-print gage is intended to be applied to the types D-1, D-2, and B-3 sanders built by the company, for use in forming core-prints, bosses, tapered pieces, etc. As may be seen in Fig. 1, it consists merely of a base which slides in the slot in the table of the machine, a stop-arm, a thumb-screw which may be used to lock the stop-arm in place, and a radius arm having a piercing point at its extreme end. After the circular pattern is drawn, the piercing point on the radius arm is placed in the center. Then the work is positioned against the abrasive disk with the right hand while holding the stop-arm lightly with the left hand. The work can now be conveniently sanded to the pattern line. When this has been done, the stop-arm is locked with the thumb-screw to prevent the radius arm and boss from going further against the disk. Then the work is revolved to sand it to the desired shape and size. Work from 1/8 to 5 inches in diameter and up to 2 inches in height can be handled with this core-print gage.

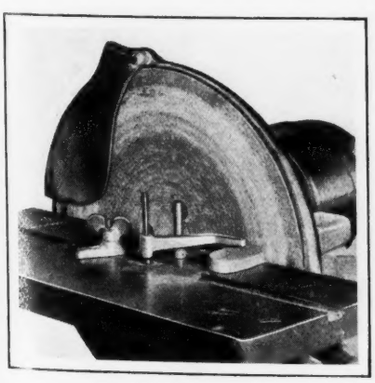


Fig. 1. Core-print Gage for Porter-Cable Sanders

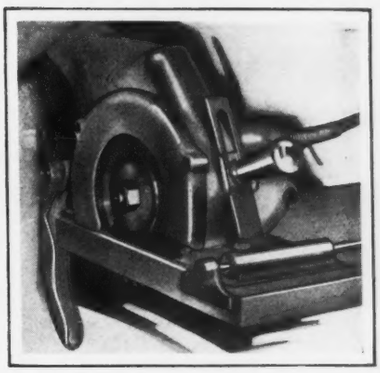
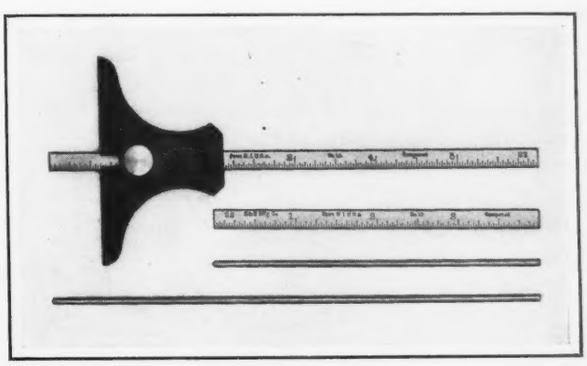


Fig. 2. Porter-Cable Motor-driven Hand Saw

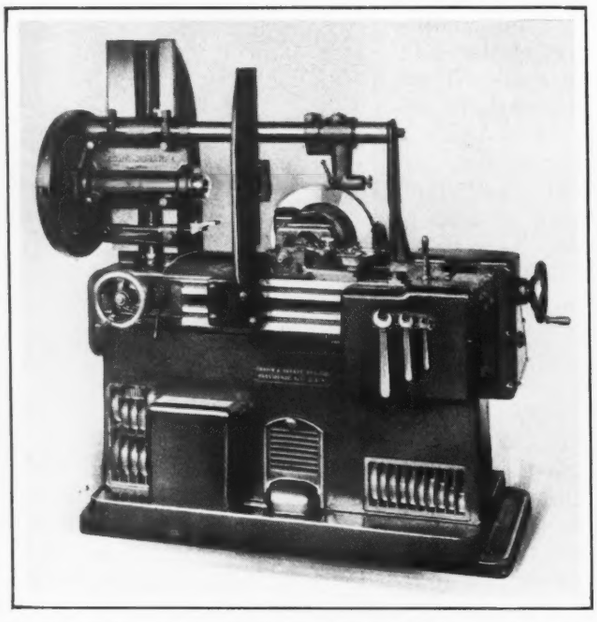
Fig. 2 shows the improved portable saw, which is based on the same principles as the saw described on page 718 of May, 1927, MACHINERY. However, the saw blade of the new device is 6 inches in diameter, whereas the blade of the previous saw measured 7 1/4 inches in diameter. The saw blade is mounted direct on a motor armature, which runs in ball bearings packed in grease. This portable saw weighs only 10 3/4 pounds, and can be readily operated with one hand. Stock up to 1 3/8 inches thick can be cut. A depth adjustment is provided, which facilitates cutting out flooring, dados, slots, etc.

BROWN & SHARPE RULE DEPTH GAGE

A rule depth gage which may be furnished with a rod in addition to the rule is being placed on the market by the Brown & Sharpe Mfg. Co., Providence, R. I. The rod is intended for use in measuring small holes, and is a convenient feature when rules cannot be employed. It is 5/64 inch in diameter. Both the rod and rule are conveniently locked in any position by turning the knurled nut on the base. The latter is about 2 1/2 inches wide. This depth gage is furnished with a 4-inch rule and with or without a 4-inch rod; or with a 6-inch rule and with or without a 6-inch rod.



Brown & Sharpe Rule Depth Gage Furnished with or without a Rod



Brown & Sharpe Improved Automatic Gear-cutting Machine

BROWN & SHARPE AUTOMATIC GEAR-CUTTING MACHINE

Several new features have recently been incorporated in the No. 3 automatic gear-cutting machine built by the Brown & Sharpe Mfg. Co., Providence, R. I., and the capacity of the machine has been increased so as to permit the cutting of gears up to 4 diametral pitch in cast iron and up to 5 diametral pitch in steel. Work up to 36 inches in diameter and up to 11 inches in face width can be handled.

The machine is now of the motor-in-base type, with the motor completely enclosed and yet readily accessible for oiling and adjustment. Power is transmitted from the motor to the machine by means of a silent chain and sprockets. The machine can also be belt-driven from an overhead countershaft if desired.

A shorter minimum stroke of 1/2 inch for the cutter-slide permits economical cutting of small gears and other parts with narrow faces. Another feature of construction is that the work-spindle slide is held positively against the upright ways at four points, two surfaces taking the direct cutter pressure. The slide is held against the ways by two taper gibs, and this direct bearing adds to the rigidity on heavy cuts. The oiling system has been simplified and improved to insure lubrication of all parts. The cutter-spindle is driven by a bronze gear receiving power from a worm sliding on a multiple-splined horizontal shaft. This positive drive eliminates any tendency for backlash to develop.

The machine is intended for use in cutting gears, sprockets, and splined shafts, for milling the teeth of cutting tools, and for innumerable other milling jobs where automatic indexing is a desirable feature.

OXWELD WELDING GLOVES

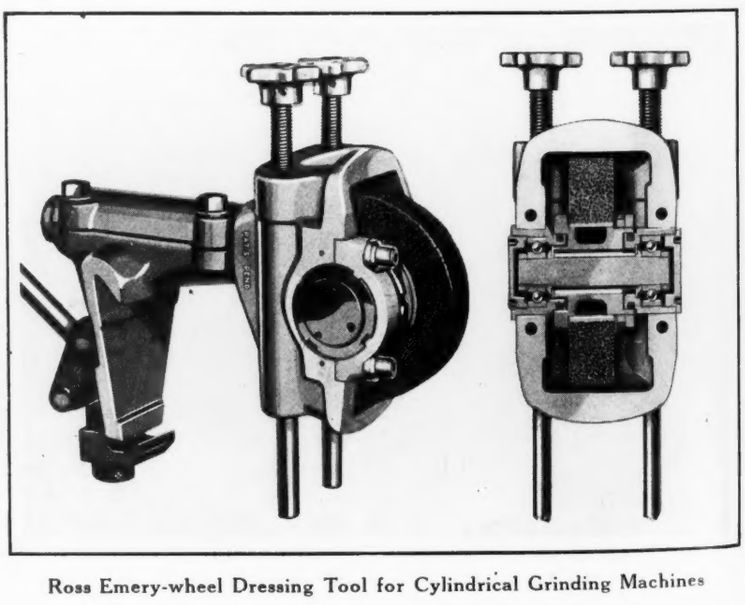
Gauntlet gloves made of a soft and pliable suede leather which is treated to prevent heat from affecting it have been added to the line of accessories for oxy-acetylene welding and cutting manufactured by the Oxweld Acetylene Co., 30 E. 42nd St., New York City. These gloves supersede the Oxweld horsehide gloves formerly supplied.

A leather strip on the thumb seam and a semicircular reinforcement on the inside seam adjoining the palm reinforce the glove. The left glove has a leather reinforcement covering the entire back between the fingers and the gauntlet, to protect the back of the left hand during cutting operations. The gauntlet is close-fitting to protect the arms. It is stated that these gloves will not stiffen or shrivel from the application of heat or from soaking in water.

ROSS EMERY-WHEEL TRUING MACHINE

A new dresser for the wheels of cylindrical grinding machines, recently introduced to the trade by the Ross Mfg. Co., 2209 Ashland Road, S. E., Cleveland, Ohio, is shown in the accompanying illustration. The hub design of this tool comprises a radical departure from previous ball-bearing types of dressers manufactured by this concern. By permitting the inner races to revolve instead of the outer races, a 40 per cent decrease in ball speed is obtained, which is said to add materially to the life of the bearings. Larger balls and the use of "machine tool" bearings mounted in hardened and ground steel cages give 60 per cent more load carrying capacity than on former designs. The bearings are of the closed type, one bearing being fixed, while the other is permitted to float in order to eliminate internal strains.

The distance between bearing centers has been doubled, with a view to reducing the leverage of thrust loads of the grinding wheel against that of the dresser. Four washers, two of which are felt and two cork, seal the bearings against grit and water. These washers are lubricated with the bearings.



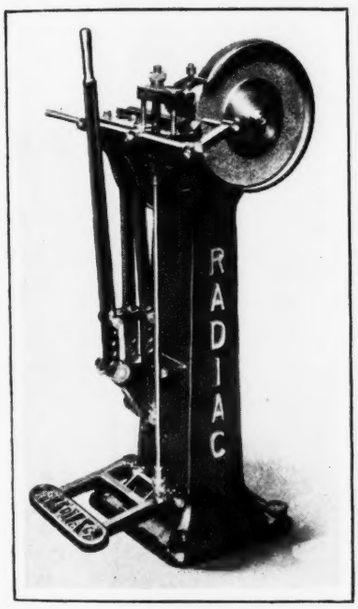
Ross Emery-wheel Dressing Tool for Cylindrical Grinding Machines

Dresser wheels may be replaced without disturbing the bearing assembly of the tool, since the wheel mounting and bearing assembly are integral. For light weight, the holder and bracket of the tool are made of Lynite.

"RADIAC" ABRASIVE-WHEEL CUTTING-OFF MACHINE

Tubing, bars, or flat stock of cold-rolled steel, high-speed steel, hardened steel, stellite, and various other alloys, may be cut off by means of a "Radiac" abrasive-wheel machine recently placed on the market by A. P. de Sanno & Son, 1615-1623 McKean St., Philadelphia, Pa. It is stated by the manufacturer that solid stock up to 1 inch in diameter can be cut off so quickly that the heat generated is not sufficient to draw the carbon or temper.

The abrasive-wheel spindle runs at 5000 revolutions per minute which, with a 12-inch wheel, gives a peripheral speed of 15,700 feet per minute. The spindle is mounted in self-aligning ball bearings contained in a head which slides on the pedestal to permit bringing the wheel to the material being cut. V-blocks are provided in which the work is placed and held by a quick-acting foot-operated clamp. This clamp grips the work on both sides of the abrasive wheel.



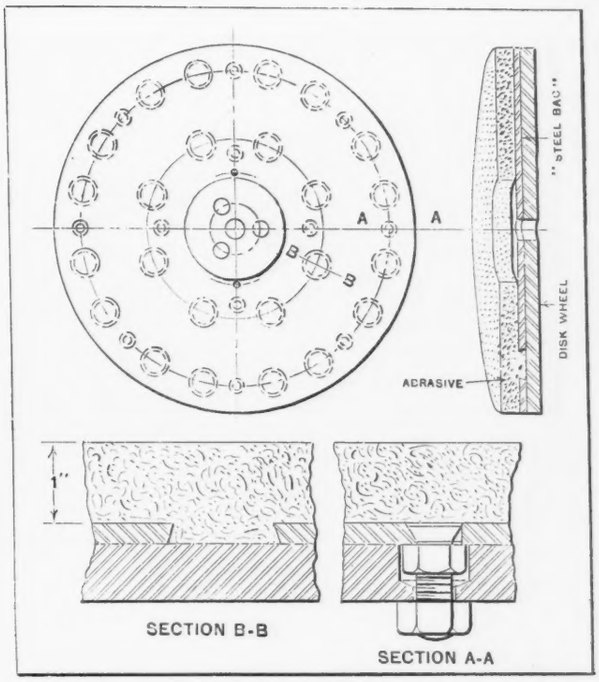
Abrasive-wheel Cutting-off Machine

In operating the machine, the operator feeds the wheel with the right hand, positions the work with the left hand, as the pieces are cut off, clamps and releases the work with one foot. The cut-off wheel is 3/32 inch thick.

BESLY "TITAN STEEL-BAC" BAKELITE ABRASIVE DISKS

Abrasive disks consisting of a comparatively thin steel plate on which the abrasive is built up are being placed on the market under the name of "Titan Steel-Bac" by Charles H. Besly & Co., 120-B N. Clinton St., Chicago, Ill. The "Steel-Bac" is bolted to the steel disk wheel of the grinding machine, and when the abrasive has been worn off, the thin steel plate can be returned to the manufacturer and rebuilt with abrasive.

The steel plates are specially rolled and flattened, and are made to various diameters and thicknesses. Artificial abrasive grains bonded with bakelite are baked on them. The plates have a series of undercut holes drilled in them which serve to anchor the abrasive to the top of the plates, the construction being clearly shown in the illustration at section *B–B*. In addition to this method of anchorage, the abrasive member is firmly held to the steel plate by a special bakelite cement. It is claimed that with this mounting it is impossible for the abrasive to loosen from the steel plate and the operator is thus completely safeguarded.

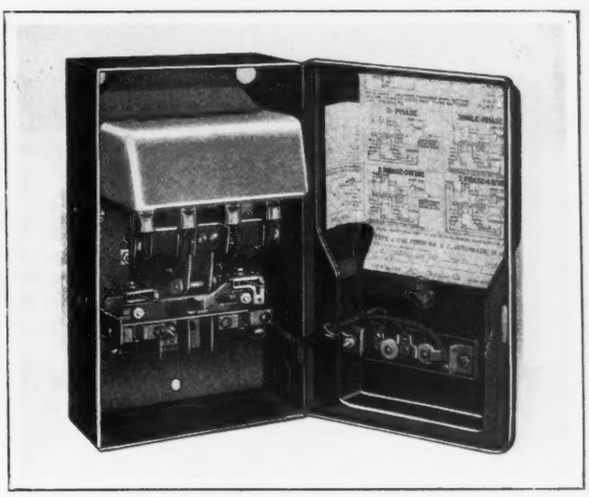


Construction of Besly "Titan Steel-Bac" Abrasive Disks

Studs are provided on the "Steel-Bac" for securing it to the disk wheel of the grinder. The special design of these studs and the manner of their use may be seen at section *A–A* in the illustration. Quick attachment to the grinding machine disk wheel is an important advantage of these abrasive disks. They can be run either wet or dry. A wide grinding zone is obtainable, which is a very desirable feature in most disk grinding operations.

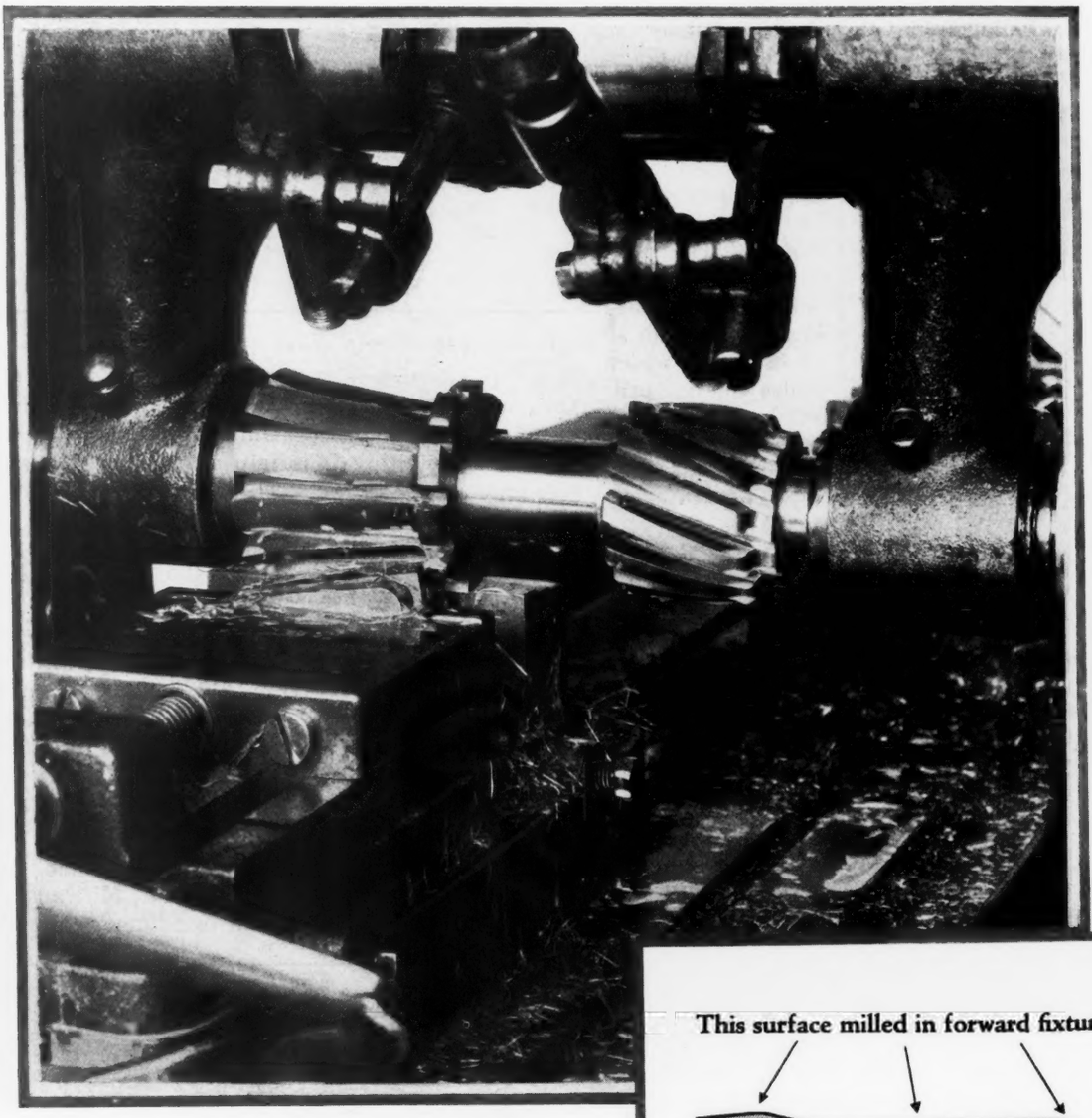
ALLEN-BRADLEY STARTER

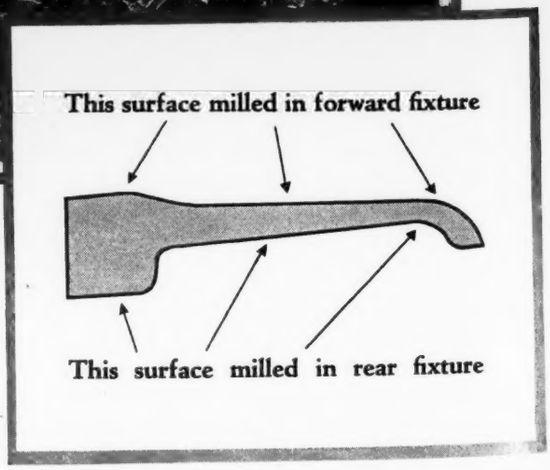
The J-1552 Form B starter previously made by the Allen-Bradley Co., 499 Clinton St., Milwaukee, Wis., is now supplied in a new and longer cabinet,



Allen-Bradley Starter with Longer Cabinet than Previous Model

TWO *Operations*—ONE M





The operator loads one fixture while the piece in the other is under cut. He takes the piece with one side milled from the forward fixture and places it in the rear one. The opposite side is milled during the second half of the table cycle. All table movements are automatically controlled by dogs.

The automatic reversal of the spindle between cuts enables the most advantageous cutting direction on the pieces in both fixtures.

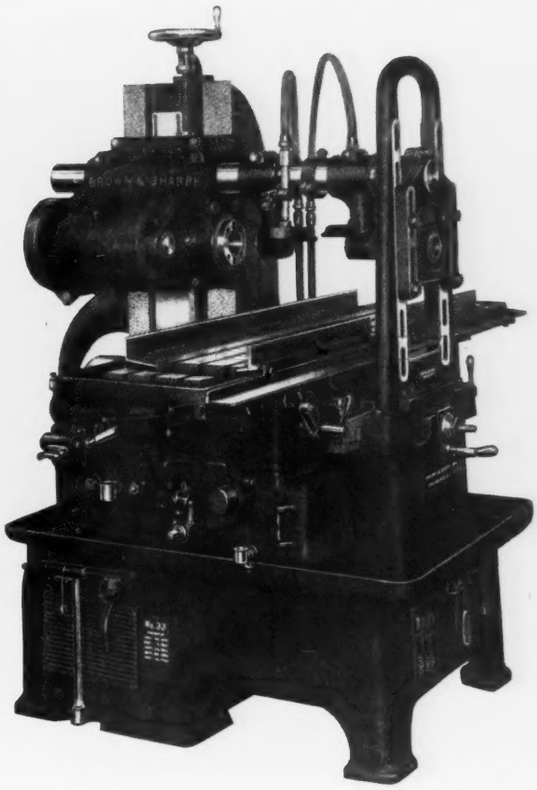
NE Machine—a finished piece each complete cycle of the table

The spindle reverse and other automatic features of the Brown & Sharpe No. 33 Automatic Milling Machine enable one machine to do the work of two

MILLING the piece illustrated required a forming cut on each of two opposite sides. By using a fixture for each operation, one at each end of the table, both of these forms are milled on the same machine. Thus, one piece is finished during each cycle of the table.

Large quantity production of this piece, which is tool steel, would ordinarily require two machines. The automatic features of the No. 33 make it possible to handle both operations on one. There is a saving in floor space and more important, an appreciable saving in labor and equipment costs.

The Brown & Sharpe Milling Service Department can recommend machines and design and build set-ups that will save time and costs in your milling department. Ask our representative about this service.



BROWN & SHARPE

BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

the new model being known as the "Bulletin 709" starter. No change has been made in the internal mechanism of the starter, and the ratings of 5 horsepower, 220 volts, and 7 1/2 horsepower, 440 or 550 volts, are the same.

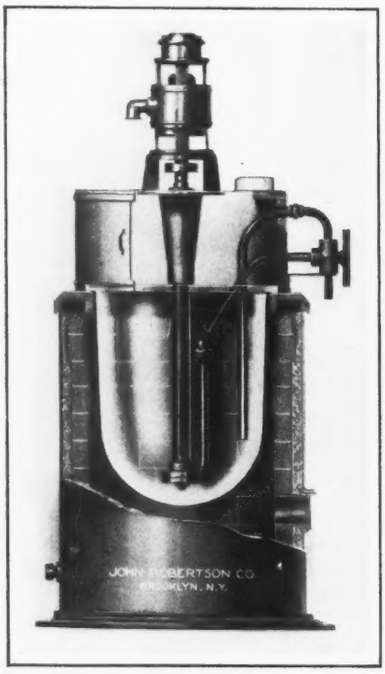
The inside length of the starter cabinet has been increased 1 7/8 inches to provide liberal space at both the top and bottom of the cabinet for convenient wiring. The starter is furnished in three forms as follows: Form 1, which has push-buttons in the cover; Form 2, which is intended for remote control; and Form 3, which is equipped with a lever switch for automatic or manual control.

* * *

ONE TON OF LEAD PUMPED PER MINUTE

A lead melting pot equipped with a motor-driven centrifugal pump having a capacity for pumping from 2000 to 2500 pounds of molten lead per minute, is shown in the accompanying illustration. This pot is a recent product of the John Robertson Co., 121-137 Water St., Brooklyn, N. Y., and is primarily intended for use in connection with large lead-encasing presses, such as are employed by the electric-cable and rubber-hose industries.

The pump is supported in a housing, and is connected by means of a flexible coupling to a vertical motor mounted on top of the hood. Both the furnace and hood are lined with insulating material and, in addition, the furnace is lined with circular firebricks. The base of the furnace is so arranged that any type of gas or oil burner can be used.



Lead Melting Pot Equipped with Pump

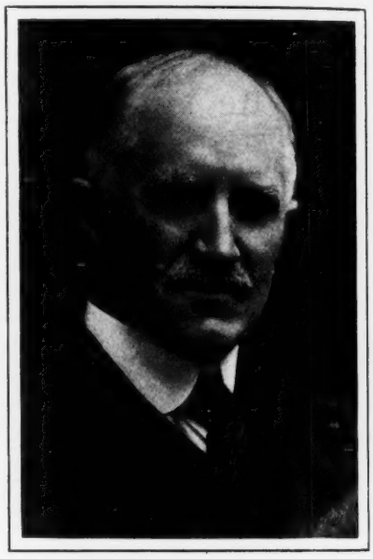
The pump is designed to operate continuously and, therefore, in addition to delivering lead to the press, it serves as an agitator and maintains a more uniform temperature in the pot. The lead is drawn off to the extrusion press by means of a stop-valve at one side of the hood. The pot illustrated has capacity for 20,000 pounds of lead.

* * *

A proposed American standard for spur gear tooth forms has recently been approved by a committee having this work in hand. The present proposal covers the 14 1/2- and the 20-degree full-depth involute system. Copies of the proposed standard may be obtained from the American Society of Mechanical Engineers, 29 W. 39th St., New York.

HEALD MACHINE CO. COMPLETES TWENTY-FIVE YEARS IN WORCESTER

At the end of 1928, the Heald Machine Co. had been located twenty-five years in Worcester, Mass., the entire period under the direct management of James N. Heald, president of the company. When the business was first moved to Worcester in 1903, the shop occupied was 90 by 100 feet and the company had 21 employes. The present plant is 200 by 600 feet and employs approximately 750 men. Forty-five engineers are employed on the design of new fixtures and tools alone. Additions to the plant were built in 1907, 1909, 1911, 1914, and 1917.



James N. Heald
President, Heald Machine Co.

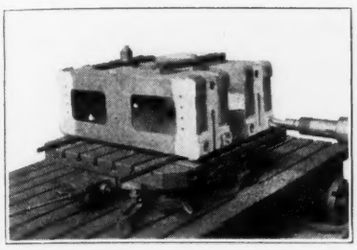
It will be recollected that as a going concern the business of the Heald Machine Co. celebrated its one hundredth anniversary in 1926, the business having been founded in 1826 in what is known as the Heald Village, Barre, Mass., by Stephen Heald, grandfather of James N. Heald. A history of the growth of the concern from this early date until the present time was given in connection with an article on the hundredth anniversary, in February, 1926, MACHINERY, page 495. It is most unusual for a firm to have been managed by the members of one family for over one hundred years, as in this case; Stephen Heald was succeeded by his son Leander S. Heald, who, in turn, was succeeded by his son James N. Heald, who became the owner of the business twenty-five years ago. Two sons of James N. Heald are now also connected with the company, Richard A. as secretary and assistant sales manager, and Roger N. as vice-president and works manager.

* * *

ARC WELDING IN PRODUCTION WORK

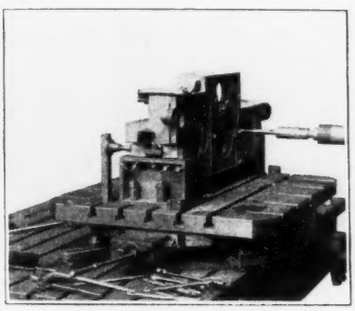
In connection with the article "Electric Arc Welding in Production Work," by Frank L. Schlick published on pages 350-352 of January MACHINERY, it should have been mentioned that this article was one of the papers submitted in connection with the Lincoln Arc Welding Prize Contest conducted under the auspices of the American Society of Mechanical Engineers last year, in which three prizes offered by J. F. Lincoln, president of the Lincoln Electric Co., Cleveland, Ohio, and amounting respectively to $10,000, $5000, and $2500, were awarded. While the paper published in January MACHINERY was not awarded a prize, it was considered of such value that it ought to be given publicity.

Performance That Talks



Grey Iron Casting 12″ wide, 18″ high, 4′ long, mounted on a 48″ revolving table and drilled from four positions with the one set-up.

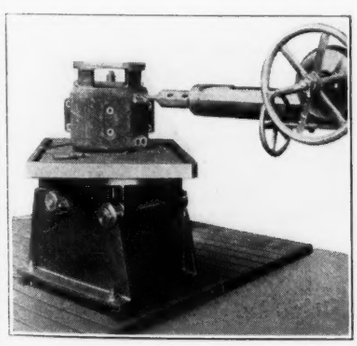
Four 1¾″ holes drilled thru 1″ material. Two 1¾″ holes drilled and reamed through ½″ material. Eight 11/16″ holes drilled through ⅝″ material. Fixed column type Ryerson Horizontal Drill used.



Drilling a cast iron trolley side, with jig. Mounted on a 4′ revolving table. Weight of casting 900 lbs.; of jig 205 lbs.

Thirteen ¾″ bolt holes drilled and spot faced through 1½″ material.

Two 1½″ holes drilled and reamed through 3¼″ material. Number 11 Ryerson Horizontal Drilling and Boring Machine used.



Drilling, Spot Facing and Back Facing Motor Frame on No. 12 Horizontal Drilling and Boring Machine. Work clamped on Universal Tilting and Revolving Table.

Material—Cast Steel—Weight—468 lbs.

4 Holes 1-5/32″ drilled thru 1¼″ metal and back faced. 8 Holes 49/64″ drilled thru ½″ metal and back faced. 4 Holes ⅞″ drilled thru 1⅝″ metal and back faced.

Drill it → Horizontally

And Save Set-Up Time

Have the next job set while the drill is busy. Use a simple, easily handled, rotary table and work four sides of a casting from the one setting. Or use a universal rotary and tilting table and work five sides from any angle at the one setting. You can save set-up time and greatly increase production with a Ryerson Horizontal.

Save Small Tools

When the drill point breaks through, there is no sudden spring that snaps the tool. Drilling pressure is against a heavy vertical column. Horizontal Drilling allows the chips to work out of the holes and gives more holes per drill grinding.

Drill Holes Cleaner and Faster

Finish the hole without stopping to pull out the drill and clean away the chips. They work out through the spiral of the drill and drop to the floor away from the work.

Get Continuous Production

The operator of a Ryerson Horizontal can plant his feet in one spot and bring the machine and work to him. He does not have to climb around and over odd-shaped castings all day. His energy goes into additional work and he is able to keep up production as the day grows.

Handle a Wider Range of Work

Small pieces on a production schedule, or the largest castings—in fact, anything in the shop—can be economically handled by the Horizontal. The flexible arrangement of the Ryerson Horizontal permits work over an exceptionally wide range.

Check up the possible savings in your shop. Investigate the Horizontal. Our engineers will be glad to work with you. Ask for Bulletin 4051

JOSEPH T. RYERSON & SON INC.
ESTABLISHED 1842

Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Pittsburgh, Philadelphia, Boston, Jersey City, New York, Richmond, Houston, Tulsa, Los Angeles, San Francisco, Denver, Minneapolis, Duluth

RYERSON
MACHINERY-SERVICE

OBITUARIES

WINTHROP INGERSOLL

Winthrop Ingersoll, president of the Ingersoll Milling Machine Co., Rockford, Ill., died at his home in Rockford on Wednesday, December 19, after a brief illness, from pneumonia.

Mr. Ingersoll was born in Cleveland, Ohio, in 1865, and it was in that city that he started the Ingersoll Milling Machine Co. Later, however, he moved the business to Rockford, Ill., where it became one of the great manufacturing establishments of that city, growing from a small concern to a large and well-known machine tool plant doing business throughout the world. Everyone engaged in the machinery field is familiar with the product of the Ingersoll Milling Machine Co., and it is not necessary here to recount the developments due to the enterprise of Mr. Ingersoll and his company.

Winthrop Ingersoll

He was, however, not only outstanding as a pioneer in one important branch of the machine tool industry; he also acquired the respect and affection of all those who knew him in a measure that few men are able to do. In commenting on his death, a man closely associated with him for many years said, "I have often thought of Winthrop Ingersoll as the ideal business man. I do not know of a man who commanded in a larger degree the respect and good will of his fellowmen. His relations with his employes were to my notion almost without parallel." To few men could a higher tribute be paid.

During the war Mr. Ingersoll was chosen, when fuel scarcity threatened, to act as County Fuel Administrator, a task which he fulfilled with the same wisdom and executive ability that always marked the administration of any enterprise in which he engaged. He was also a director of the Forest City National Bank.

Mr. Ingersoll gave to the city of Rockford the Clayton C. Ingersoll Memorial Park in that city, and he was prominent in the civic, social, and athletic life of the community. In 1887, he married Miss Harriet Caskey, who survives him. He is also survived by one daughter, Mrs. Robert Gaylord of Rockford, Ill., one son, Harold Ingersoll of Colorado Springs, Colo., and five grandchildren.

MARTIN HAWKE

Martin Hawke, managing director of the Carborundum Co., Ltd., Manchester, England, died December 20 at the age of sixty-six years. He was born in Cornwall, England, and came to this country as a young man, being first employed by the Hudson-Chester Granite Co., at Chester, Mass. There he became interested in "Carborundum," and in August, 1900, he entered the employ of the Carborundum Co., Niagara Falls, N. Y., and was appointed its European Continental representative. For several years he traveled in Europe in the interest of this company, establishing agency representations in many countries.

In 1912, the plant of the Carborundum Co., Ltd., was built at Manchester, England, Mr. Hawke being active not only in planning the plant, but in getting it into production. Upon its completion, he was made managing director.

Mr. Hawke was widely known not only in the industrial fields of England and Continental Europe, but also in this country. He was a man who made many friends and held them. His long and efficient service in the interest of the company he represented won for him the esteem of all his fellow-workers both in England and here. He is survived by his widow and two sons, Irving Hawke, sales manager of the Carborundum Co., Ltd., at Manchester, and Clarence E. Hawke, sales engineer of the Carborundum Co., Refractory Division, Perth Amboy, N. J.

HENRY B. WHITNEY, superintendent of the Axle Division of the General Motors of Canada, Ltd., Walkerville, Ont., died at the Metropolitan General Hospital, Windsor, Ont., on December 3 from an attack of pneumonia, at the age of forty-eight. Mr. Whitney had previously been connected with the Russell Motor Car Co. of Toronto, and the Davenport Machine Tool Co. of Rochester, N. Y. He is survived by his wife, a daughter, and two sons.

WILLIAM G. ALLEN, founder of the Allen Mfg. Co., Hartford, Conn., former president of the American Specialty Co., and inventor of the Allen safety set-screw, died in Hartford on December 28 at the St. Francis Hospital, following a long illness. Mr. Allen was born at Rockville, Conn., in 1861, and was for many years connected with the Henry & Wright Mfg. Co. of Hartford, of which he was sales manager at the time of his death.

FRANK HERBERT PAGE, president of the National Equipment Co., Springfield, Mass., died Wednesday, December 19. Mr. Page was also treasurer of the Van Norman Machine Tool Co., a director of the Package Machinery Co., and a director of the Springfield National Bank, all of Springfield, Mass.

PERSONALS

HORACE ROSS, for many years assistant purchasing agent with Henry Disston & Sons, Inc., Philadelphia, Pa., has been made assistant manager of steel sales.

F. E. HAZARD has joined the Meadows Mfg. Co., Bloomington, Ill., as director of sales. Mr. Hazard has had twenty-five years' experience in the sales field.

ROBERT M. GATES, manager of the Industrial Department of the Superheater Co., 17 E. 42nd St., New York City, has been elected vice-president of the company.

C. M. GRANNIS, formerly with the Mechanical Department of the Lamson Co., Syracuse, N. Y., has joined the selling organization of Crane-Schiefer-Owens, Inc., 501 Morgan Building, Buffalo, N. Y.

M. A. GORDY has been appointed southeastern manager for the United States Electrical Tool Co., Cincinnati, Ohio. Mr. Gordy's headquarters will be at Atlanta, Ga., in the Norris Building on Peachtree St.

ARTHUR F. MOUL has been elected a director and secretary of Samuel C. Rogers & Co., Buffalo, N. Y., makers of machine knife and saw grinders. Mr. Moul joined the Rogers organization in June, 1924, and has been manager for the last three years.

JUDD W. SPRAY has been appointed vice-president and general sales manager of the Timken Roller Bearing Co., Canton, Ohio. Mr. Spray has been general sales manager since 1926, and previous to that was sales manager of the automotive division of the company in Detroit for several years.

F. MARTIN BUCKINGHAM has been transferred from the Wallace Barnes Co., Bristol, Conn., to Hamilton, Ont., Canada, where he has assumed the duties of general manager of the Wallace Barnes Co., Ltd. An addition to the plant is just being completed which practically triples its floor space and capacity.

A. W. F. GREEN has been appointed a sales representative of the Poldi Steel Corporation of America, 245 W. 18th St., New York City. Mr. Green has been associated for twelve and one-half years with the John Illingworth Steel Co. as metallurgist. During the last five years he has also acted as service and sales metallurgist for that company.

WILLIAM J. HANLEY and CHARLES K. WEST have been elected commercial vice-presidents of the General Electric Co., Schenectady, N. Y., in charge of the commercial activities of the company in the districts in which they now are managers. Mr. Hanley is manager of the East Central district, with headquarters at Cleveland, and Mr. West, of the Atlantic district, with headquarters at Philadelphia.

R. W. OTT has been appointed sales manager of the Oesterlein Machine Co., Cincinnati, Ohio, manufacturer of milling machines and universal and cutter and tool grinders. Mr. Ott started his career by serving a regular apprenticeship, and in his earlier years worked at the trade as

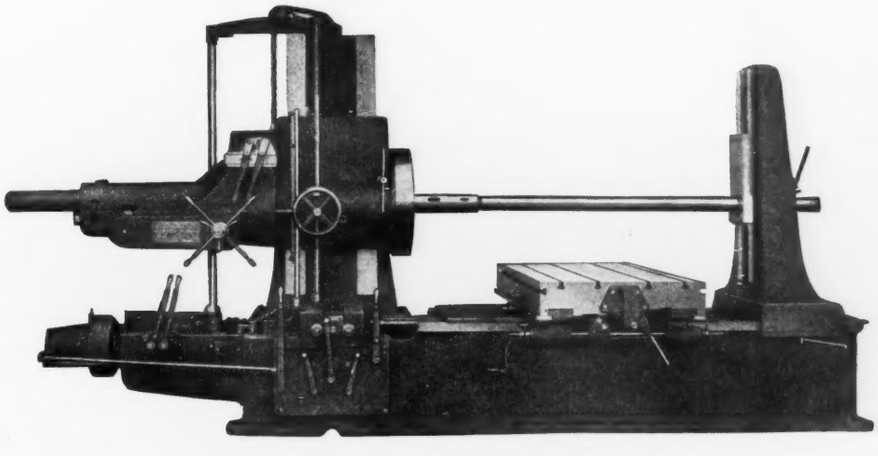
The Basis of Reputation is Quality

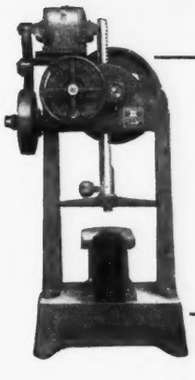
The Reputation of the

"PRECISION"

Boring, Drilling and MILLING MACHINE

is Good





WE ALSO MAKE THE

LUCAS POWER
Forcing Press

THE LUCAS MACHINE TOOL CO., Cleveland, Ohio, U.S.A.

FOREIGN AGENTS: Allied Machinery Co., Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo. Ing. M. Kocian & G. Nedela, Prague. Emanuele Mascherpa, Milan, Italy.

toolmaker. Latterly, he has been engaged in executive positions in high-production plants and has also had an intensive training in the sales field.

W. C. STETTINIUS has resigned as president and general manager of the American Hammered Piston Ring Co., Baltimore, Md. He will remain on the board of directors of the company and will be vice-chairman of the board. ALLEN W. MORTON, who has been connected with the company in various capacities for the last ten years, and who has been vice-president for the last three years, has been elected president and general manager.

A. M. OLIVER, for six years in the advertising department of the Goodyear Tire & Rubber Co. at Akron, Ohio, has become advertising manager of the Pangborn Corporation, Hagerstown, Md., manufacturer of sandblast and dust collecting machinery. Mr. Oliver had been connected with the Goodyear Corporation for more than thirteen years, and previous to that was engaged for five years in engineering work in Austria and the United States, specializing on tire design and rubber machinery.

JULIAN KENNEDY, who for the last fifty years has been engaged in the design of blast furnaces and steel mill equipment and is the holder of 160 patents on devices applicable in this field, was awarded the 1928 medal of the American Society of Mechanical Engineers at the annual dinner of the society held in connection with its annual meeting in New York. Mr. Kennedy, who is now seventy-six years old, has among other achievements to his credit the design of every plant built during the last forty years for the manufacture of locomotive wheel tires.

EDWIN H. PEIRCE has resigned as vice-president and general manager of the Niles Tool Works Co., coincident with the merger of that company and the Hooven, Owens, Rentschler Co. Mr. Pierce will remain a director of the Niles-Bement-Pond Co. Previous to his association with the Niles Tool Works Co., he was connected for nineteen years with the United States Steel Corporation as superintendent of the New Haven Works and the South Works at Worcester, Mass. of the American Steel & Wire Co. No announcement has yet been made in regard to his future plans.

R. L. MATTHEWS has joined the sales force of the Chicago branch office of the Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo. Ever since leaving Purdue University, where he studied electrical engineering, Mr. Matthews has been active in the electrical field, being connected with such organizations as the Michigan Bell Telephone Co., the Armstrong Cork & Insulation Co., and the National Electric Products Corporation. N. H. SPENCER has been added to the Dallas, Tex., sales force of the company. Mr. Spencer has had twenty years experience in the electrical field, during which time he has held several managerial positions.

H. L. R. EMMET has been appointed manager of the Erie, Pa., works of the General Electric Co. and J. E. Brobst has been made manager of the Bloomfield, N. J., plant, succeeding Matthew Griswold at Erie and C. D. Knight at Bloomfield, both of whom retired from active service January 1, because of ill health. Mr. Emmet has been with the General Electric Co. since 1912, and has been production manager of the Schenectady works since 1922. Mr. Brobst has been with the company since 1903, and has been engineer of the industrial control engineering department at Schenectady since 1920. He will continue to act in the capacity of engineer of the industrial control department, having general supervision over the engineering departments at both Schenectady and Bloomfield.

GEORGE J. WILLMAN, formerly manager of the Cleveland office of the Haynes Corporation, Chicago, Ill., has been made president and treasurer of the Haynes Corporation of Cleveland, a newly formed organization with offices in the Union Trust Building, Cleveland, Ohio. This organization will represent the Haynes Corporation in the northern half of Ohio, the eastern part of Michigan and the western parts of New York and Pennsylvania. T. J. PHEE, for several years supervising engineer for the Haynes Corporation in the Chicago territory, has been made vice-president and secretary of the new company. Announcement is also made of the organization of the Haynes Corporation of Cincinnati, which will represent the Haynes Corporation in the southern half of Ohio and in several states south of Ohio.

TRADE NOTES

BULLARD MACHINE TOOL CO., Bridgeport, Conn., announces that the firm name has been changed to the BULLARD CO.

ROSS MFG. CO. has removed its offices and factory to larger quarters with increased facilities at 2209 Ashland Road, S. E., Cleveland, Ohio.

H. BOKER & CO., INC., 103 Duane St., New York City, have been appointed eastern agents for the sale of Kinite, an air hardening alloy steel manufactured by the Kinite Corporation of Milwaukee, Wis.

BROWN & SHARPE MFG. CO., Providence, R. I., announces that on and after February 1 the Philadelphia office of the company will be located at 1102 Elverson Building, Broad and Callowhill Sts., Philadelphia, Pa.

ATLAS MFG. CO., of New Haven, Conn., and the ANSONIA NOVELTY CO., of Ansonia, Conn., have merged, and will hereafter be known as the ATLAS-ANSONIA CO. The new concern will be located at 54-62 Grant St., New Haven, Conn.

POLLARD BROS. MFG. CO., INC., 4034 N. Tripp Ave., Chicago, Ill., manufacturer of shop furniture and factory equipment, has appointed the Rayl Co., 228 W. Congress St., Detroit, Mich., distributor of Pollard products in the Detroit territory.

GILBERT & BARKER MFG. CO., Springfield, Mass., has made arrangements with M. K. Epstein, Springfield, Mass., formerly manager of the company's industrial sales division, to handle the sales of the oil burning equipment made by the company.

BROWN INSTRUMENT CO., Philadelphia, Pa., has moved its New York office from 50 Church St., to Room 1502 Roebling Building, 117 Liberty St., where larger quarters have been obtained to provide for the increased staff now attached to this district office.

GEORGE A. ORROK, consulting engineer in the general mechanical engineering, power plant, hydro-electric, gas, and coke fields, announces the removal of his offices from 124 E. 15th St. and 17 Battery Place to Room 1208, 52 Vanderbilt Ave., New York City.

CONWAY CLUTCH CO., 1962 W. 6th St., Cincinnati, Ohio, has appointed the Watson-Flagg Engineering Co., Paterson, N. J., distributor of Conway disk clutches in New Jersey, and the Brewster-Nicholas Co. of Cleveland, Ohio, distributor of the Conway product in Detroit, Cleveland, Northern Ohio, and Michigan.

REED-PRENTICE CORPORATION, Worcester, Mass., has appointed the following agents in the territories mentioned: Crane-Schiefer-Owens, Inc., Buffalo, Rochester, and Syracuse, N. Y.; English Bros. Machinery Co., Kansas City, Mo.; McDonald Machinery Co., St. Louis, Mo.; Neff, Kohlbusch & Bissell, Inc., Chicago, Ill., and Milwaukee, Wis.

FOOTE BROS. GEAR & MACHINE CO., 215 N. Curtis St., Chicago, Ill., has opened a New York branch office in the Woolworth Building. E. A. Phillips will be in direct charge of the New York branch, which will have control of all territory in the New England states, New York as far west as Rochester, and the northern half of New Jersey.

FRANK TOOMEY, formerly president of Frank Toomey, Inc., has moved to 130 N. Third St., Philadelphia, Pa. The business will be conducted in the future under the name of FRANK TOOMEY MACHINERY CO. ARTHUR S. DAY, formerly connected with the Day Machinery Co., Buffalo, N. Y., is now associated with the Frank Toomey Machinery Co.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa., has taken over the assets of the R. D. Nuttall Co. and will carry on the operations of the company as a branch of the Westinghouse Electric & Mfg. Co. The Nuttall plant will be known as the Nuttall Works of the Westinghouse Electric & Mfg. Co. The product will be called Westinghouse-Nuttall.

JOSEPH MONAHAN, for the last thirteen years sales manager for the McMullen Machinery Co., Grand Rapids, Mich., has established an engineering sales agency for machine tools and other metal-working machinery and will represent manufacturers desiring direct representation in that district. Mail should be addressed to P. O. Box 517, Grand Rapids, Mich.

LINCOLN ELECTRIC CO., Cleveland, Ohio, manufacturer of Stable-Arc and Link-Weld motors, has appointed J. E. Durstine, district sales representative of the company for the

4 Reasons

Wetmore Adjustable Six-blade Standard Finishing Reamer with arbor integral.

Why WETMORE Reamers Cut Production Costs

Production men in many of the largest plants are specifying Wetmore Adjustable Reamers because Wetmores have proved—on actual tests—that they do *better, more accurate work at less cost.* Here are four features that make Wetmore the reamer preferred by men who know what it can do:

Adjustments to the thousandth of an inch can be made in less than a minute. In fact, the Wetmore is the quickest and easiest adjusting reamer made.

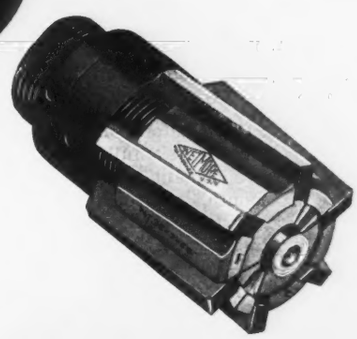
Solid alloy steel body, heat-treated, guaranteed against breakage.

Left Hand Angle Cutting Blades that prevent digging in, chattering and scoring while backing out. Shearing effect of blades increases life of cutting edge.

No grinding arbor required for regrinding. Wetmore Reamers can be reground on their original centers.

Wetmore Adjustable Six-blade Standard Finishing Reamer with arbor separate.

Wetmore Blades are carried in stock for all types of Wetmore Reamers. Best high-speed steel, ground to thickness, length, and on seat. In ordering, give type and size of reamer and whether reamer is to be used on steel, cast iron, or bronze, etc.



Give a Wetmore Reamer a trial on a good stiff job and compare its work with that of reamers you've been using. You be the judge—and we'll rest our case with you.

Send for Catalog No. 26, showing full line of Wetmore Adjustable Reamers—and reduced prices.

WETMORE REAMER CO.
60 27th Street, Milwaukee, Wisconsin

WETMORE ADJUSTABLE REAMERS
"THE BETTER REAMER"

Southeast, with headquarters at Birmingham, Ala. H. P. Egan has been promoted to the position of district sales representative for central Ohio, with headquarters at Columbus, Ohio.

MACHINE PRODUCTS CO., E. 179th St. and St. Clair Ave., Cleveland, Ohio, has changed its name to the OHIO GEAR CO. The need for this change has long been felt, as the products of the company for the last ten years have been chiefly gears and splined shafts. This business will be continued, and the company will also handle stock gears and speed reducers. There has been no change in the personnel or location.

BRAUN GEAR CORPORATION, 1323 Gates Ave., Brooklyn, N. Y., has bought the entire gear division of the Micarta Fabricators, Inc., of Brooklyn, which formerly operated under the name of ACCURATE GEAR CORPORATION. The entire gear department of this company has been moved into the factory of the Braun Gear Corporation. These additional facilities will enable the output of the company to be increased 50 per cent.

HUSKY WRENCH CO., Kenosha, Wis., has changed its name to the HUSKY CORPORATION. The company has recently moved into a new factory containing 40,000 square feet of floor space. It is constructed of brick, concrete, and steel, is well lighted and ventilated, and equipped with modern machinery for making Husky socket wrenches and other Husky products. A new office building has also been constructed close to the factory.

LOGANSPORT MACHINE CO., 529 Market St., Logansport, Ind., manufacturer of the Logan air-operated chucks and labor-saving devices, has purchased the plant formerly occupied by the Logansport Furniture Co. This building contains sufficient floor space to double the output of the Logan devices, and there is provision for additional expansion if required. F. B. Wilkinson is president, and Frank G. Payson, general manager.

MAGNETIC MFG. CO., Milwaukee, Wis., manufacturer of "High-Duty" magnetic separators, magnetic clutches, and special magnetic equipment, announces that its products now bear the trade name "Stearns," in addition to the former trade name "High-Duty." The new designation is derived from the names of company officers, R. H. Stearns, president and treasurer, and R. N. Stearns, secretary. No change will be made in the firm name.

NILES TOOL WORKS CO., formerly owned by the Niles-Bement-Pond Co., and the HOOVEN, OWENS, RENTSCHLER CO., both of Hamilton, Ohio, have been consolidated under the ownership of the GENERAL MACHINERY CORPORATION. The officers and directors of the General Machinery Corporation are: President, G. A. Rentschler; vice-presidents, William B. Mayo, A. A. Byerlein, and Curtis T. Zeigler; and secretary and treasurer, Walter A. Rentschler.

WILCOX-RICH CORPORATION and the RICH TOOL CO. have consolidated. Hereafter the latter company will be operated as the Rich Tool Division of the Wilcox-Rich Corporation. All production and engineering activities will be continued at 1501 E. Ferry Ave., Detroit, Mich. The sales and accounting departments will be combined with the other divisions of the company at 6-240 General Motors Building, Detroit. The personnel of the Rich Tool Co. will remain unchanged.

TIMKEN STEEL & TUBE CO., Canton, Ohio, has constructed a new mill which was started on a full-capacity production schedule on January 17. The plant has a capacity of 30,000 tons of alloy steel per month. A wide variety of sections and sizes of hot-rolled bar stock or seamless tubing can be supplied, as well as special alloy steels made to any specified analysis. Construction has also been started on a new tube mill, 320 feet wide by 420 feet long, which is expected to be in operation by April 1.

SIMONDS SAW & STEEL CO., Fitchburg, Mass., announces that the prizes in the sixth annual economic contest, provided by Alvan T. Simonds, president of the company, have been awarded. Essays were submitted on the subject "Who Ultimately Pays the Taxes?" The first prize, $1000, was awarded to Professor Henry F. Walradt, Ohio State University, Columbus, Ohio; the second prize, $500, to William J. Shultz, financial economist of the National Industrial Conference Board, New York City. Honorable mention was made of Harold Cunningham, Montreal, Canada.

HUNTER SAW & MACHINE CO., 5662 Butler St., Pittsburgh, Pa., has appointed Moyer, White & Co., 2644 Lenox Ave., Detroit, Mich., exclusive agents for the company in the Detroit territory, and James A. Lenfesty, Cambridge Arms, North Charles and 34th St., Baltimore, Md., as exclusive agent in the Baltimore and Washington territory. These agents will handle the complete line of Hunter products, including metal-cutting circular saw blades, inserted-tooth saw blades, high-speed cut-off sawing machines, pneumatic hammer rivet sets and chisel blanks, and hardened steel specialties.

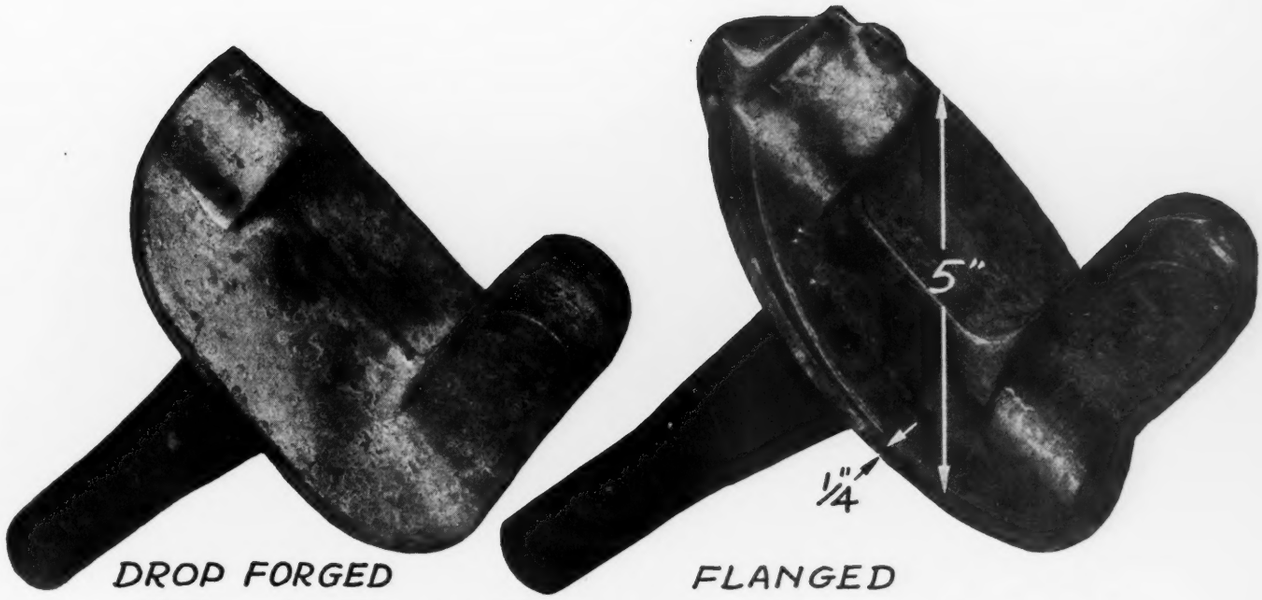
GEARS AND FORGINGS, INC., Cleveland, Ohio, has just completed a three-story addition to its Cleveland plant. The addition provides approximately 20,000 square feet of manufacturing space, and is primarily intended for the production of speed reducers. The manufacture of all the company's speed reducers under 50-horsepower capacity is being shifted to the Cleveland plant. At the same time, the capacity of the plant for small and medium-sized gears will be increased. The large reduction units of special design will be produced at the company's plant at Ford City, Pa., the same as heretofore.

LINCOLN ELECTRIC CO., Coit Road and Kirby Ave., Cleveland, Ohio, is offering the free use of a film entitled "Modern Manufacturing with a 'Stable-Arc' Welder." This is an interesting technical film containing three reels of standard size film, suitable either for large or small audiences. It is also available in the 16-millimeter film size. The film shows how to design for welded steel construction and how welded products are made. The history of the commercial use of welding is breifly traced up to the present time. Various applications of welding show the possibilities of this new process of joining metal.

CUTLER-HAMMER MFG. CO., 1204 St. Paul Ave., Milwaukee, Wis., manufacturer of electric motor control, wiring devices, and allied products, has changed the firm name to CUTLER-HAMMER, INC. The new company is organized as a Delaware corporation with the following officers: President, B. L. Worden; vice-presidents, F. L. Pierce and J. C. Wilson; treasurer, H. F. Vogt; and secretary, W. C. Stevens. In this change from a Wisconsin to a Delaware corporation the Cutler-Hammer Mfg. Co., of Milwaukee, the Cream City Foundry Co., of Milwaukee, and the Cutler-Hammer Mfg. Co. of New York are united under one name.

BEMIS & CALL CO., Springfield, Mass., announces that it has acquired all rights to the manufacture and sales of Coes wrenches, formerly made by the Coes Wrench Co. of Worcester, Mass., and has combined these wrenches with its own line of wrenches, all of which will be manufactured at Springfield. J. C. McCarthy & Co. of New York, who have been representatives for the Coes Wrench Co. for more than seventy years, will have the exclusive sale of all the Bemis & Call wrenches in the East, including Pennsylvania, New York, and the New England states. John K. Wilson & Co. of Baltimore will continue to represent the company in the southern states, from Maryland south, including Texas. Guy R. Muzzy will have charge of the sales in the Central States, as at present.

SHEPARD-NILES CRANE & HOIST CORPORATION has been formed by a combination of the Shepard Electric Crane & Hoist Co. of Montour Falls, N. Y., and the Niles Crane Corporation, formerly a division of the Niles-Bement-Pond Co. Through the combining of the facilities, experience, and engineering knowledge of these two organizations, the new corporation will be in a position to provide a full line of standard and special traveling cranes and electric hoists. The combination also includes the Sprague Division of the Shepard company. The Shepard plant at Montour Falls, N. Y., and the Niles plant at Philadelphia, Pa., will be continued in operation for the production of the equipment for which the facilities of the plants have been designed, and the three divisions of the new corporation will operate, respectively, as the Shepard Division, the Niles Division, and the Sprague Division. The officers of the new corporation are Colonel Edward A. Deeds, chairman of the board; S. G. H. Turner, chairman of the executive committee; Frank A. Hatch, president; Sydney Buckley, first vice-president; James A. Shepard, vice-president; and Robert T. Turner, vice-president.



What's Your Toughest Upsetting Job?

ONE that takes the life right out of a forging machine and makes it grunt on the final stroke.

Ten to one it's a thin flanging job with no cushion, where the dies and heading tool come "metal to metal":—the kind that breaks piston rods on steam hammers and crankshafts on forging machines.

Flanging jobs test a forging machine and Ajax Machines stand the test. Flanges 5″ in diameter ¼″ thick; 11″ in diameter 1″ thick and big fellows 15″ in diameter 1½″ thick are turned out by Ajax Machines by the hundred thousands, day in and day out without break-downs.

The tie rod re-enforced bed with rigid crankshaft housings; the sturdy twin gear driven crankshaft; and the drop lock that converts a maximum of flywheel energy into actual work are merely three of the exclusive Ajax construction features you should acquaint yourself with before buying a forging machine.

Our Bulletin 63 will be sent upon request. Or better still, let one of our sales engineers call.

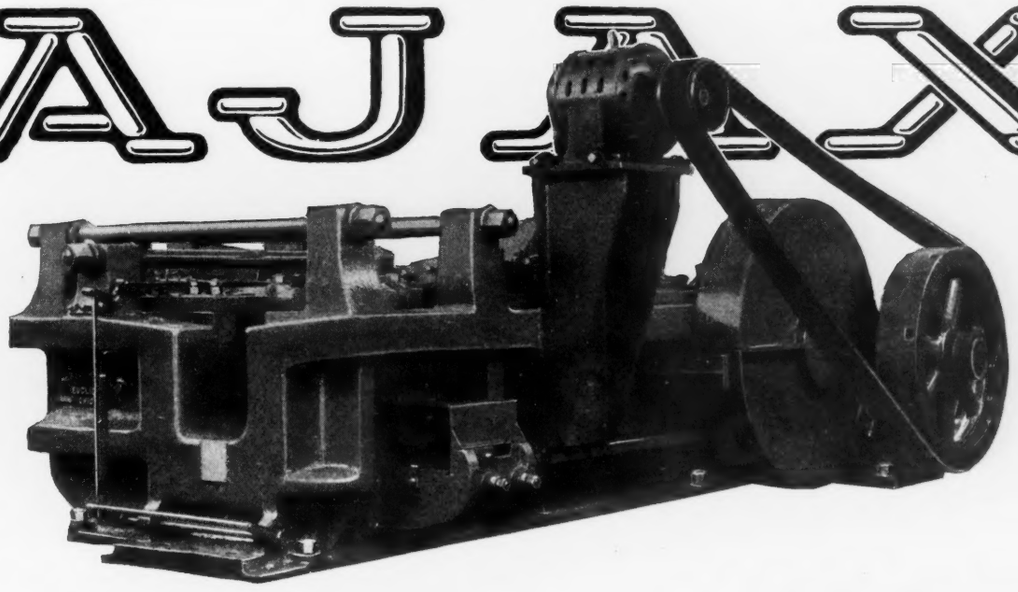
THE AJAX MANUFACTURING COMPANY

621 Marquette Bldg.
140 So. Dearborn St.
Chicago, Ill.

Euclid Branch P. O.
Cleveland, Ohio

1369 Hudson Terminal
50 Church St.
New York City

AJAX



COMING EVENTS

MARCH 21-23—Regional meeting of the American Society of Mechanical Engineers at Knoxville, Tenn. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

APRIL 8-12—American Foundrymen's Association convention at Hotel Stevens, Chicago, Ill. Headquarters of association, 140 S. Dearborn St., Chicago, Ill.

MAY 6-11—Twelfth exposition of the chemical industries to be held at the Grand Central Palace, New York City.

MAY 13-15—Meeting of the American Society of Mechanical Engineers at Rochester, N. Y. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

MAY 16-18—Annual meeting of the American Gear Manufacturers' Association to be held at the Hotel Statler, Cleveland, Ohio. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland, Ohio.

JUNE 24-28—Annual meeting of the American Society for Testing Materials at the Chalfonte-Haddon Hall Hotel, Atlantic City, N. J. C. L. Warwick, Secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

JULY 1-4—Summer meeting of the American Society of Mechanical Engineers at Salt Lake City, Utah. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

SEPTEMBER 9-13—Annual convention of the American Society for Steel Treating at Cleveland, Ohio. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

SEPTEMBER 9-13 — Eleventh National Metal Exposition under the auspices of the American Society for Steel Treating at the Cleveland Public Auditorium, Cleveland, Ohio. For further information address W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland.

CALENDARS RECEIVED

SIVYER STEEL CASTING CO., Milwaukee, Wis., is distributing to the trade a large wall calendar showing three months on each sheet.

GENERAL ELECTRIC CO., Schenectady, N. Y. Calendar for 1929, containing an illustration in colors on each sheet of various applications of electricity.

MOLINE TOOL CO., Moline, Ill., manufacturer of the "Hole Hog" line of multiple-spindle machines, is distributing a calendar for 1929 to the trade.

LOCKWOOD GREENE ENGINEERS, INC., 100 E. 42nd St., New York City. Calendar for 1929, showing on each sheet various factories erected by the company.

NEW DEPARTURE MFG. CO., Bristol, Conn., manufacturer of ball bearings, is distributing its annual calendar for 1929—a triple-padded "three-months-at-a-glance" wall calendar.

CARNEGIE STEEL CO., Carnegie Bldg., Pittsburgh, Pa. Annual safety calendar for 1929, containing on each page a safety poster submitted by school boys and girls between 6 and 18 years of age in the annual safety poster contest held by the company.

NEW BOOKS AND PAMPHLETS

SEAMLESS TUBING—A BIBLIOGRAPHY. By Victor S. Polansky. 78 pages, 5 by 7 inches. Published by the Carnegie Library, Pittsburgh, Pa.

HACKSAW BLADES. 12 pages, 6 by 9 inches. Published by the Department of Commerce, Washington, D. C., as Simplified Practice Recommendation R90-28.

LABORATORY TESTING OF AUTOMOBILE REAR AXLES. By E. Wooler, Chief Engineer of the Timken Roller Bearing Co. 15 pages, 8 1/2 by 11 inches. Distributed by the Timken Roller Bearing Co., Canton, Ohio.

ABSTRACTS OF SCIENTIFIC AND TECHNICAL PUBLICATIONS. No. 1, 87 pages, 6 by 9 inches; No. 2, 72 pages, 6 by 9 inches. Published by the Massachusetts Institute of Technology, Cambridge, Mass.

DISCUSSION OF THE NATIONAL ELECTRICAL SAFETY CODE (1928). 334 pages, 5 by 7 1/2 inches. Published by the Department of Commerce, Washington, D. C., as No. 4 of the Handbook Series of the Bureau of Standards. Price, $1.

THE SURFACE TENSION OF MOLTEN METALS (Part II). By Earl E. Libman. 22 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 187 of the Engineering Experiment Station. Price, 15 cents.

NOTE ON THE EFFECT OF REPEATED STRESSES ON THE MAGNETIC PROPERTIES OF STEEL. By M. F. Fischer. 12 pages, 6 by 9 inches. Published by the Department of Commerce, Washington, D. C., as Research Paper No. 26 of the Bureau of Standards. Price, 5 cents.

TRACTIVE RESISTANCE OF AUTOMOBILES AND COEFFICIENTS OF FRICTION OF PNEUMATIC TIRES. By T. R. Agg. 60 pages, 6 by 9 inches. Published by the Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa, as Bulletin No. 88 of the Engineering Experiment Station.

STATISTICS OF RAILWAYS IN THE UNITED STATES. 274 pages, 9¼ by 11½ inches. Prepared by the Bureau of Statistics of the Interstate Commerce Commission, Washington, D. C., as the Forty-first Annual Report on the Statistics of Railways in the United States for the year ended December 31, 1927.

PATENTS—LAW AND PRACTICE. By Oscar A. Geier. 46 pages, 6 by 9 inches. Published by Richards & Geier, Patent and Trademark Attorneys, 274 Madison Ave., New York City. Distributed without charge.

This is the fourth edition of a book containing a digest of the law and practice pertaining to patents. A great many changes have been made in the rules of practice of the United States Patent Office since the third edition of this treatise was published in June, 1924. The book has therefore been brought up to date in the present edition. It covers such subjects as the assignment of patents, application charges, foreign patents, the working of patents, infringements, ownership, etc.

PHOTOMICROGRAPHS OF IRON AND STEEL. By Everett L. Reed. 253 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $4, net.

This book presents a set of photomicrographs of iron and steel, some of which have been subjected to mechanical and thermal treatments according to standard practice. The heat-treatments applied have generally been those recommended by the Society of Automotive Engineers. These photomicrographs illustrate the microstructure of iron and steel in their many aspects. Complete details of the material and its treatment are given under each illustration. The author has brought together these photomicrographs in book form with the hope that they will prove of assistance to those interested in the production, treatment, and use of these metals.

MECHANICAL WORLD YEAR BOOK (1929). 348 pages, 4 by 6 1/4 inches. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price 1/6d, net.

This is the forty-second edition of this well-known little handbook for mechanical engineers. The present edition contains several new sections, among which is one on helical springs, in which an endeavor has been made to eliminate many of the troublesome calculations usually necessary and present useful information on this subject in a concise form. Another new section gives notes and data on flywheel proportions, while still another contains information on compressed air. Among the other additions may be mentioned tables on mild steel tubes, wire ropes for cranes, valve rod ends, price equivalents, economical life of plant and machinery, decimals of £1, comparative stresses, and thermometer scales.

MATERIALS HANDBOOK. By George S. Brady. 428 pages, 4 by 7 inches. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $4.

This little handbook is an encyclopedia of materials for purchasing agents, engineers, executives, and foremen. It gives in convenient form the chief distinguishing data on the raw materials of engineering and manufacturing. The following materials are covered: Abrasives; brasses and bronzes; building materials; corrosion-resistant alloys; cupro-nickel alloys; fabrics, leathers, organic materials; fibers; finishing materials; heat-resistant alloys; industrial chemicals; irons; light alloys; metals; military chemicals and commercial explosives; minerals; miscellaneous alloys; oils and greases; ores; refractories; resins, gums, waxes; steels; white metals; and woods.

PRODUCTION DESIGN. By J. K. Olsen. 212 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $3.

This book, for the designer and draftsman, deals with the subject of design and specification with especial reference to quantity production. It discusses the important question of tolerances and fits, and gives representative examples of production design problems encountered in the general manufacturing field. An idea of the contents will be obtained from the following list of chapter headings: Production Specification, Tolerances, and Fits; Press Fit and Running Fit; Push Fit and Free-operating Fit Tolerances; Knurling and Serration Fits; Grinding, Drill, and Punch Tolerances; Swedging and Heading Allowances; Percentage Allowances in Figuring Pile-ups; Production Gears and Gear Centers; Stampings and Die-made Parts; Chamfer and Clearance Holes; Fastening, Locking, and Compensation Means; Production Screw Thread; American Standard Screw Threads; A Compendium of Production Raw Materials; Raw-material Gages; Heat-treatments; and Finishes.

NEW CATALOGUES AND CIRCULARS

ELECTRIC FITTINGS. Crouse-Hinds Co., Syracuse, N. Y. Bulletin 2126, containing data on threadless condulets, couplings, and connectors.

GRAPHITE BEARINGS. United States Graphite Co., Saginaw, Mich. Pamphlet illustrating steps in the production of "Gramix" self-lubricating bearings.

ROLLER CHAIN. Diamond Chain & Mfg. Co., Indianapolis, Ind. Pamphlet showing applications of Diamond roller chain in the lumber and woodworking industries.

NICKEL CAST IRON. International Nickel Co., Inc., 67 Wall St., New York City. Pamphlet giving analysis for twelve foundry mixtures for nickel cast iron suitable for various uses.

SMALL TOOLS. Morse Twist Drill & Machine Co., New Bedford, Mass. First of a series of open letters, containing information on Morse drills, reamers, cutters, taps, and dies.

WIRE-FORMING MACHINERY. Baird Machine Co., Bridgeport, Conn. Circular illustrating Baird automatic equipment for forming wire and ribbon metal, and the Baird horizontal six-spindle chucking machine.

SPEED REDUCERS. Lamb Engineering & Equipment Co., 1666 W. Ogden Ave., Chicago, Ill. Circular giving ratios, horsepower, and prices for the speed reducing units made by this concern for small motor application.

PIPE AND NOZZLES. Taylor Forge Division of the American Spiral Pipe Works, Chicago, Ill. Circular outlining the advantages of the new Taylor seamless forged-steel nozzle for boilers, pressure vessels, and penstocks.

LATHES. Porter-Cable Machine Co., Syracuse, N. Y. Catalogue of "Hi-Speed" produc-

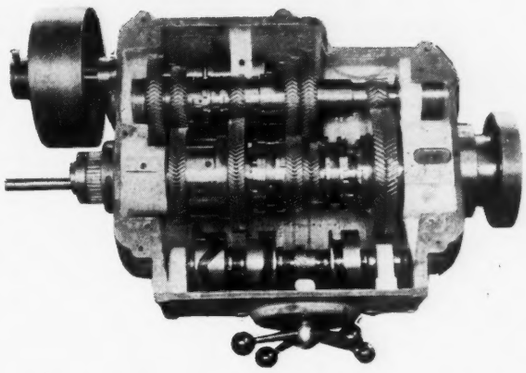
2/3 less

time required to change speeds on

MONOTROL GEARED HEAD LATHES

Actual stop watch time — proves conclusively that the operator can change spindle speeds on a Monotrol with less effort and in 2/3 the time taken on any other lathe.

This is due to the exclusive Monotrol Headstock design where all gears, constantly in mesh, are controlled by a single lever.

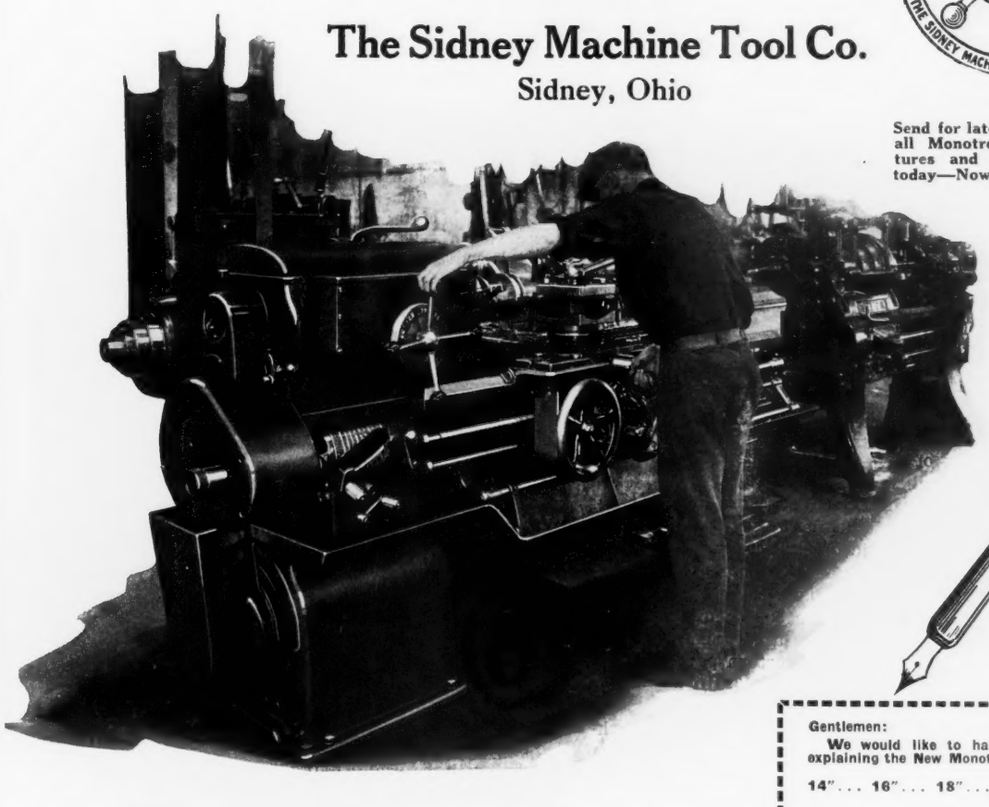


Saving of time, ease of control and accurate results — all combine to make Monotrol Geared Head Lathes the most economical lathe obtainable.

MONO LEVER CONTROL
MONOTROL
TRADE MARK
THE SIDNEY MACHINE TOOL CO. SIDNEY, OHIO

The Sidney Machine Tool Co.
Sidney, Ohio

Send for latest literature giving all Monotrol's exclusive features and advantages. Write today—Now!



effortless control!

USE the Coupon for Convenience.

Gentlemen:
We would like to have you mail literature explaining the New Monotrol Geared Head Lathe.

14"... 16"... 18"... and 20"..... sizes.

Name .....

Company .....

City..... State.....

M-4

tion lathes, containing a detailed description of these lathes, as well as examples of multiple tooling for various classes of work.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletins GEA-408A, 874C, and 876B, treating, respectively, of GE electric heating equipment for industrial ovens; type WD-200A arc welder; and type WD-400A arc welder.

MILLING MACHINES. Ingersoll Milling Machine Co., Rockford, Ill. Circular showing typical examples of Ingersoll special milling, drilling, and boring machines built in 1928, which vary in weight from 4000 to 400,000 pounds.

ALLOY STEELS. American Manganese Steel Co., 333 N. Michigan Ave., Chicago, Ill., is distributing a publication entitled "New Applications and Unusual Uses for Amsco Manganese Steel, Fahralloy, and Other Amsco Alloys and Products."

INDICATING, RECORDING, AND CONTROLLING INSTRUMENTS. Brown Instrument Co., 4485 Wayne Ave., Philadelphia, Pa. Pamphlet illustrating several applications of the Brown automatic control pyrometer applied to oil-fired furnaces.

WELDING EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Leaflet 20398, describing arc-welding accessories, including helmets, hand shields, metal electrode holders, carbon electrode holders, welding cable, and welding circuit reactors.

MATERIAL HANDLING EQUIPMENT. Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. Bulletins illustrating Cleveland tramrail systems applied to the handling of steel products and material in warehouses.

NICKEL STEEL. International Nickel Co., Inc., 67 Wall St., New York City. Circular No. 13 of a series on nickel steel data and applications. The present bulletin deals with torsion, impact, and other mechanical properties of SAE—3130 nickel-chrome steel.

SHOP FURNITURE. Pollard Bros. Mfg. Co., Inc., 4034 N. Tripp Ave., Chicago, Ill. Catalogue on shop furniture and equipment, giving specifications for the Pollard line of factory equipment, which includes steel work benches, racks, bench legs, frames, trucks, pans, etc.

ELECTRIC EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Leaflet L-20384, describing a new fan-cooled totally enclosed squirrel-cage induction motor designed for use in locations where the service conditions are too severe to permit the use of a standard open motor.

SEGMENT CHUCKS. Samuel C. Rogers & Co., 199 Dutton Ave., Buffalo, N. Y. Circular illustrating the features and construction of the new Rogers 12- and 14-inch segment wheel chuck, which is adapted for use on vertical and universal grinders, as well as on various makes of machine knife grinders.

STEEL SASH WINDOWS. Detroit Steel Products Co., Detroit, Mich. Booklet entitled "Daylighting and Airation the 'Fenestra' Way," explaining some of the results of a research conducted by the company to establish on a definite basis the procedure for proper daylighting and airating of industrial buildings.

VARIABLE - SPEED TRANSMISSION. Reeves Pulley Co., Columbus, Ind. Circular outlining the advantages of the Reeves variable-speed transmission, which is built in sixteen different sizes, covering capacities from fractional to 150 horsepower, and gives ranges and speed adjustability from 2 to 1 up to 16 to 1 ratios.

CONVEYING EQUIPMENT. Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. Bulletin entitled "Cleveland Tramrail Answers the Demand for Speed and Endurance," illustrating applications of the Cleveland tramrail system in cases where speed and endurance are required.

ELECTRIC EQUIPMENT. Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo. Bulletin 138—"Manual of Electrical Testing"—containing information on the testing of single-phase and polyphase motors, and the testing of transformers for core loss, copper loss, polarity, insulation, temperature rise, and efficiency.

ARC-WELDING EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletin GEA-1022A, descriptive of an automatic arc-welder for steel railroad ties. Bulletin GEA-823B, descriptive of GE atomic-hydrogen arc-welding equipment for the hand-welding of very thin metals or metals and alloys hitherto considered unweldable.

NICKEL CAST IRON. Whitehead Metal Products Co. of New York, Inc., 304 Hudson St., New York City. Bulletin illustrating typical applications of nickel cast iron. The bulletin outlines the improved characteristics of nickel iron castings, discussing the points of improved machineability, uniform structure, increased strength, and increased hardness.

GRINDING MACHINES. Gardner Machine Co., 414 E. Gardner St., Beloit, Wis. Booklet entitled "Typical Jobs for Standard Gardner Grinders," illustrating actual applications of these machines on a variety of work. Complete details are given relative to each of the jobs illustrated, including type of work, type of machine, operations performed, and production obtained.

HORIZONTAL BORING, DRILLING, AND MILLING MACHINES. Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Catalogue illustrating and describing the G. & L. No. 50 high-power precision, horizontal boring, drilling, and milling machine, which is the latest addition to the G. & L. line of horizontal boring machines. General specifications of the machine are given.

BEARINGS. Bearium Bearings, Inc., 261 Franklin St., Boston, Mass. Pamphlet entitled "Common Sense About Bearings," outlining the physical properties and characteristics of "Bearium." The pamphlet also discusses the function and types of bearings in general, as well as the materials used in different types. Information on the practical application of this bearing metal and a list of typical applications is included.

CARBORUNDUM FINISHING COMPOUNDS. Carborundum Co., Niagara Falls, N. Y. Pamphlet descriptive of the Carborundum brand of finishing compounds. The pamphlet outlines the characteristics of these compounds, and lists the different grades in which they are made and the use for which each is adapted. It also contains recommendations for the proper materials for various classes of work, as well as directions for use.

PIPE CUTTING AND THREADING MACHINES. Curtis & Curtis Co., 324 Garden St., Bridgeport, Conn. Catalogue of Curtis pipe cutting and threading machinery, illustrating and describing these machines in detail and giving specifications for the various styles and sizes. Tables of sizes of iron water pipe, iron pipes specifications, and cutting speeds for pipe are included. Copies of this catalogue will be sent to those interested upon request.

THREADING MACHINERY. Landis Machine Co., Inc., Waynesboro, Pa. Catalogue 32, illustrating and describing the Landis line of threading machines, staybolt threading machines, bolt factory threading machines, automatic forming and threading machines and chaser grinders. A detailed description of the Landis die-heads and chasers is given, and specifications for the various sizes are included. The catalogue also gives the capacity and standard equipment for the various styles and sizes of threading machines shown.

USED MACHINE TOOLS. Simmons Machine Tool Corporation, Albany, N. Y. Catalogue listing the lines of used machine tools that this company carries. Typical examples of the different types of machines available are illustrated, and a complete description, with necessary specifications, code, cubical contents and weight, is given for each machine shown. Attention is called to the fact that the machines illustrated represent a standardized stock, which will always be available, owing to the fact that as the machines are sold they will be replaced by others that are duplicates in type and condition, but of later design.

THE ITALIAN MACHINERY INDUSTRY

An interesting review of the Italian machinery industry is given in a recent number of *Commerce Reports*. The capital invested in the machinery industry in Italy is close to $100,000,000, and in the automobile industry about $50,000,000. A striking characteristic of Italian industry is the relatively small scale on which individual companies operate. According to the industrial census taken in October, 1927, out of 731,000 employers, less than 5000 employed more than 100 workers each, and these firms are concentrated in a small area in the northern and northwestern part of Italy. Only 286 plants employed from 500 to 1000 workers, and only 140 over 1000 workers.

Four hundred sixty-four plants with more than 100 workers each are engaged in the production of machinery. Two hundred fifty of these plants have from 100 to 250 workers; 115 have between 250 and 500 workers; 56 have between 500 and 1000 workers; and 43 over 1000 workers. The machinery production in Italy is now so far advanced that in certain lines the country may be said to be self-supporting. This is particularly true in regard to locomotives and railroad cars, heavy electrical machinery, hydraulic equipment, pumps, and the more common types of metal-working machines. There is, however, a very small amount of machinery manufactured for special purposes or designed for high production.

* * *

NEW HAVEN EXHIBITION CANCELLED

The general committee of the New Haven Machine Tool Exhibition at its last meeting decided not to hold the eighth New Haven Machine Tool Exhibition tentatively announced for 1929. The New Haven Machine Tool Exhibition was first organized in 1921 as an educational enterprise, working in the interest of the machine tool industry. In view of the fact that the National Machine Tool Builders' Association is now holding its own expositions, the first one in 1927 and the second announced for the fall of 1929, the committee has concluded that to hold two exhibitions in the same field during one year would be unnecessary, and hence, no plans are being made for an exhibition in New Haven this year.

* * *

Action without thought is like shooting without aim. Thought without action is equally useless.